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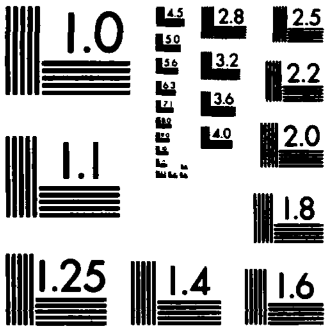

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Monterey, California

THESIS

OFFICE AUTOMATION: A LOOK BEYOND
WORD PROCESSING

by

Milan Ephriam DuBois Jr.

June 1983

Thesis Advisor: D. R. Dolk

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Word processing was the first of various forms of office automation technologies to gain widespread acceptance and usability in the business world. For many, it remains the only form of office automation technology. Office automation, however, is not just word processing, although it does include the functionof facilitating and manipulating text. In reality, office automation is not one innovation, or one office system,

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Office Automation: A Look Beyond Word Processing

by

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Word processing was the first of various forms of office automation technologies to gain widespread acceptance and usability in the business world. For many, it remains the only form of office automation technology. Office automation, however, is not just word processing, although it does include the functionof facilitating and manipulating text. In reality, office automation is not one innovation, or one office system, or one technology, but rather it is the integration of a broad set of office system, information processing and communications technologies. Office automation encompasses a wide span of applications which will be examined individually as well as collectively. Additionally, this thesis will take a cursory look at the problems of implementing an automated office and the possible impact it can have on human office workers. The purpose of this thesis is thus to provide a capsulated examination of what office automation is, what it consists of, what applications are available, and how it can be implemented.

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I. INTRODUCTION

"Office automation", "office of the future", or "electronic office" are examples of a terminology which has developed since the mid 1930's and which has received its greatest emphasis since the origin of data and word processing in the 1960's. It implies a change in the ways white-collar workers perform their jobs. In the broadest sense of the term, it is people using technology to improve human productivity. Like other forms of automation, office automation is only a tool to enhance performance, it is not an "end all" to the growing problems confronting management in the white-collar productivity sector. Above all, it is not to be construed as a replacement for people but rather an alternative means to the laborious, time-consuming way people have traditionally performed their work.

Perhaps the concept of office automation is best summed up in the following words by Arnold Keller, vice president and publisher of Infosystems magazine:

> "Too many people view office automation as a replacement for people. We hear and read about the electronic office and the paperless office. Regarding the latter, we are reminded of the statement of Bob Murray, vice president of the Diebold Group. Said Bob, 'You show me the paperless office and I'll show you the peopleless office. But you show me first'."
>
> "An so it will be with the office of the future. Not paperless. Not peopleless. But rather an office adapting today's technology to the needs of the worker. Paperwork

> will be simplified, not eliminated. People will be present but more productive. Technology will be more humanized. The office will become an effective management information center, and people will play the major role."

The intent of this work is to present an overview of what an automated office is, what it is composed of, and what it does. Because it is still a rather new and undefined concept as well as a rapidly evolving technology, there has been little opportunity to bring together the various facets of office automation into one source of reference. This thesis is an attempted compilation of the primary attributes of that technology, commencing with an historical preview and a layman's working definition of office automation provided in Chapter II.

Chapter III takes a look at why office automation is a growing concern in organizational circles and how and where it can be applied to enhance efficiency and effectiveness of the people it serves. Chapter IV is a synopsis of what types of information are handled by the various forms of technology and discusses the very heart of office automation – the communication links that bring it all together.

Office automation is the linking of multiple components in such a way that information can be processed and handled with a maximum of technical assistance and minimum of human intervention. Chapters V and VI, which represent the bulk

of this work, are devoted to the actual forms of technology being utilized today and how they are integrated to form office systems.

Chapter VII is a presentation of the problems associated with the implementation of an automated office as well as the benefits that can be gained at both the managerial and clerical levels. It looks at office automation from a military perspective and how it is currently being used and how it can be put to better use throughout the military environment.

Every attempt has been made throughout this thesis to remove the technical terminologies associated with the various subject matters in an effort to provide a clear and uncomplicated perspective of the equipment and technologies available. Additionally, specific product names and types have been purposely omitted to avoid commerical promotions or endorsements of one product over another. Readers interested in individual equipment specifications, applications and costs are referred to the many commerical vendors associated with the sale and promotion of such products.

II. BACKGROUND

A. GENERAL

Although the terms "office of the future", "automated office", and "electronic office" have been used in and around the business world as well as data processing departments for over 20 years, the concept has been growing for over 130 years. As early as the 1850's there were "writing machines" which were beginning to change the way offices and businesses had long done their business. With the advent of precision manufacturing and interchangeable parts as a by-product of the Civil War, dozens of companies began to manufacture typewriters and by 1900 more than 100,000 typerwriters had been sold [Ref. 1:p. 149]. Additionally, by 1900 numerous other inventions (such as the telegraph, the telephone and dictating machines) which were the forerunners of today's automated office products had established places in the office. The typewriter, however, was the catalyst changing the way businesses performed daily office work.

As the evolutionary era of the typewriter progressed there came an increase in the size of offices as well as their number, the number of people employed in offices increased, the types of jobs changed, and even the social aspects of the office changed as women were integrated into the office environment for the first time [Ref. 1:p. 149].

These changes remained static for over half a century with very few continued improvements in the office until the 1960's when the term "office of the future" appeared along with the first word processors.

Word processors have opened a new era in the way businesses perform their work. They revolutionized the information (text, data, image, and voice) handling tasks in the office and were the first of various forms of office automation technologies to gain widespread acceptance. For many companies, word processing is the only form of office automation in current use today. In fact, Charles C. Hall, Vice-President for word processing at Lanier Business Products, estimates that as of May 1982,

> "...about 500,000 secretaries have word processors and that about as many more do enough typing to be logical prospects for getting one". [Ref. 2:p. 184].

Another well-known leader in the office automation industry, Amy Wohl, claims there are already over one million word processors in use [Ref. 3]. The case for increasing office automation facilities will be discussed in Chapter 3.

B. DEFINITION

As significant as it has become and as rapidly as it has grown, word processing represents only a single aspect of the office of the future. The "office of the future", "automated office", "electronic office", "paperless office" or the broader term "office automation" (henceforth referred

to as OA) is not one innovation, or one office system, or one technology, but rather it is the integration of a broad set of office systems, information processing, and communication technologies to help people manage information. OA is as revolutionary to the office of today as the typewriter was to the office at the turn of the century. It's changing how we do business, the nature of business, the types of jobs that are performed as well as how they are performed and significantly affecting the social aspects of the office at both the managerial and secretarial level.

C. USE AND EFFECT

Office automation is a concept, an approach to a new way of distributing information. Its components touch almost every segment of business from finance to organizational structure. When linked together the multiple components form a cohesive network in

> "...such a way that information, once entered, can be processed and channeled from point to point with a maximum of technical assistance and a minimum of human intervention". [Ref. 4: p. 2]

Office automation is innovation and technology serving people, enabling them to augment their intellectual capabilities and to expand traditional methods of office applications. It's a way of rethinking and a change in perspective, questioning not just how a business functions, but why. It asks the questions of who does what and how?

It addresses the issues of management as well as measuring the productivity of labor. It touches everyone at all levels.

OA effects the way businesses carry out their day-to-day operations, why people travel and the reasons they meet. Overcoming traditional boundaries, teleconferencing, electronic mail, voice mail, facsimile, and telephones have significantly changed the way people communicate and provided increased flexibility as well as a wide range of alternatives to the way people work. No longer is geographical location a primary consideration. Through OA, information can be transferred almost anywhere, anytime, from or to any remote location such as a telephone booth, a motel room, a community work center, an office at home, or even from a mobile phone installed in a car, motor home, boat, or plane. Through the use of communication technology, OA has literally expanded the office to infinite possibilities and localities, and narrowed the scope of human environment.

D. BENEFITS

Office automation provides more than just expanded geographical capabilities and freedom; it provides a host of opportunities and benefits to business, tangible and intangible. Many of these attributes will be explored in Chapter 3. The potential savings are enormous as indicated in two landmark studies conducted on OA users. The first

of these, which will be mentioned many times throughout this work, was done by the consulting firm of Booz, Allen and Hamilton over a year long study of 15 large U.S. corporations. It gave conclusive evidence that within just five years of implementation knowledge workers (executive management) could save an average of 15% of their time through more highly automated support. Roughly half the savings would come from reducing time spent in less productive activities. The balance would be derived from selective reductions in certain meetings, analytical tasks and document handling [Ref. 5: pp. 148-150]. Additionally, companies would receive a complete return on their investment within 15 months [Ref. 6].

The second study by Cresop, McCormick and Paget, Inc., of Chicago, Illinois, done on a large group of companies with at least $50 million in annual sales, found that users averaged 30 percent savings on administration costs, primarily through word processing; a 26 percent increase in productivity of administrative personnel; and a 20 percent increase in productivity of managers and professionals [Ref. 7]. Furthermore, David Barcomb, author of Office Automation: A Survey of Tools and Technology, cites the following benefits that businesses and knowledge workers can derive from the proper implementation of OA technology [Ref. 4: p. 7]:

Optimize staffing
  Enhance human capabilities
  Conserve human resources
  Compensate for manpower shortages
  Minimize drudgery

Increase productivity
  Improve accuracy
  Speed up throughput
  Speed up turnaround

Gain competive edge
  Improve timeliness of information
  Improve decision making
  Conserve natural resources

Increase scope of control
  Enhance individual and organizational flexibility
  Make information portable

Decrease expenses
  Reduce capitol investments in structures
  Reduce or cap off payroll costs

Chapter 3 and Chapter 6 make a case for adopting office automation by taking a closer look at the benefits and opportunities to be gained.

E. LEVELS OF OFFICE AUTOMATION

The final portion of this chapter and a significant part of Chapter 6 deals with one of the basic premises of OA – it must be carefully documented and made a part of the strategic plan of the company or organization in which it is to be implemented. Too aggressive an approach in order to "catch up" or be the "first" to implement an OA system is as dangerous, and generally more expensive, than not having OA at all.

Looking into the future, one author identifies six levels of office automation implementation (Figure 2.1), each involving successively bigger steps into the integration of OA and communication technologies as well as management level decision making [Ref. 8: pp. 19-22].

Decision Support Systems

Integration of Computer and Communications
Technology with Management Policy

Personalized and Custom Office Systems
as an Aggregate of Office Routines
and Computer Resources

Uses of Communications for Integrating
Discrete Processing Functions to Allow
Efficient Office Systems

Collection, Storage, Reporting and
Distribution of Text at Level of Conceptual
Completeness

Collection, Storage, Reporting and
Distribution of Data by Different Nonconnected
Devices

Figure 2.1. Levels of Office Automation.

At the bottom of the pyramid is collection, storage, reporting and distribution of data. This is accomplished via classical office equipment, i.e., data entry equipment, electric typewriters, copiers, dictating machines, facsimile, and mini- or microcomputers, each a separate entity from the other. The emphasis is on increasing the efficiency of secretarial tasks, but does little for management.

The next level involves the collection, storage, and reporting of text at some level of integration. This includes conceptual integration which allows devices to be integrated into some form of system without major modifications or revisions. Typical forms of equipment include word processors, typesetting, and other microprocessor supported equipment such as printers, video display terminals, and disk drives. There is still very little direct benefit to management. This is the level a great many organizations are currently at and will remain. It is also the starting point of this thesis. From here, we look ahead towards levels of greater electronic support and communications which will allow all office workers to be more productive, both in efficiency and effectiveness.

The third level on the pyramid reflects the use of communications technology for the integration of discrete processing fuctions to allow more efficient office systems. At this level the equipment includes facsimile transmission and receiving terminals and copiers, multistation business computers, word processing units capable of integration into OA system networks, electronic mail, and interactive devices as the building blocks for decision support systems. Emphasis on managerial support is evident at this level through the interface of electronic mail (eventually electronic voice).

At the fourth level of office automation are personalized and customized office systems built to support the unique professional and secretarial activities of the organization, integrating the office with the computer resources of the firm. Equipment at this level include databases, word processing, electronic mail, electronic filing and informational retrieval, calendaring and on-line information systems. Management should be completely involved at this level as it begins to realize the full potential for large monetary savings and benefits at the executive level.

The integration of computers and communications technology with management policy is the basis of the fifth level of OA. At this level of organization, OA supports management policy and decision making. It is a significant element of organizational structure linking the firm together via distributive networks. The system may be hierarchical, horizontal or a combination thereof [Ref. 9: Chapters 4, 7, 8, 9]. It is highly integrated with management. The goal at this level is not just to be labor supportive but to ensure that information is disseminated in a more timely fashion and the full range of equipment available in OA is utilized to meet the overall objectives and strategic plans of the company.

The final level of office automation at the top of the pyramid calls for computer-based decision support systems. Decision support systems are high level managerial tools

utilizing an inventory of mathematical and application models to forecast, experiment, simulate, prepare graphics and address the "what if" questions of upper level management. This level of OA represents the full attainment of automation within the office and implies the ultimate in integration of technologies within the organization, including data processing, communications, and management. It is office automation at its most advanced stage, serving the knowledge worker to its greatest capacity.

III. MAKING A CASE FOR OFFICE AUTOMATION

A. GENERAL

Chapter 2 discussed how office automation is revolutionizing the way people and organizations conduct their daily transactions, how they travel, how they communicate, and how they structure organizational plans and objectives. Additionally, it concluded that there are enormous savings to be manifested both tangibly and intangibly through the implementation of OA and its applications to white-collar productivity. In this chapter we take a closer look at both how those benefits are derived and just what they are. It looks at what shall henceforth be referred to as the three P's of office automation: people, paper, and products. For our purposes herein, "people" refers to the end users of OA, the white-collar segment of industry, both managerial and clerical. The term "paper" will assume a generalized definition implying the type and nature of work performed by white-collar employees, and "products" will denote the techniques and type of equipment necessary to generate that paper product. These three items form the nuclei of OA and should be the relevant decision factors in the organization's determination to automate and how far to automate the office environment.

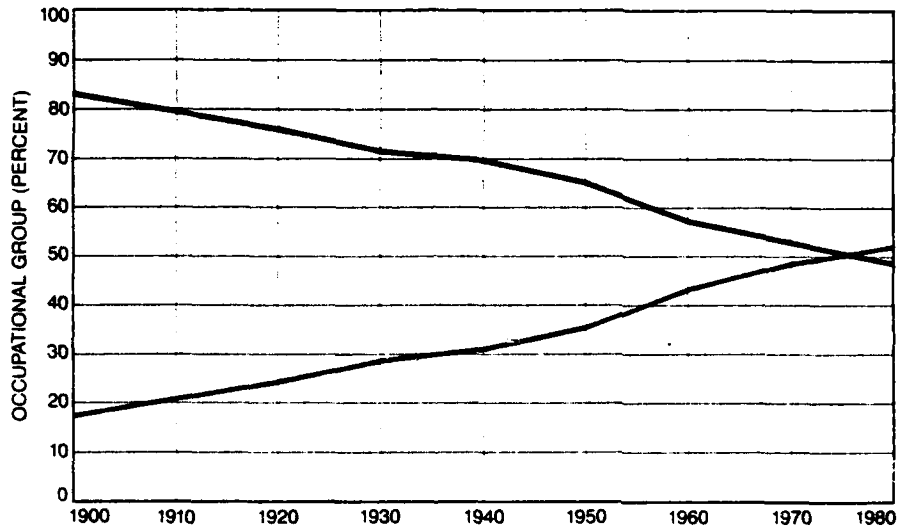
The final section of this chapter is devoted to the management and control functions of office automation and

how they can be enhanced through the implementation of OA. These issues raise significant questions about the changing scenario of white-collar productivity, particularly when viewed from the perspective of the changing labor force from blue-collar to white-collar predominance as illustrated in Figure 3.1 [Ref. 1: p. 154].

B. PEOPLE

As stated previously, the primary goal of office automation is to help people manage information. This must remain the paramount principle in the design and implementation of any OA system because it is people, not machinery, who convert data into knowledge. Machinery and the complex systems that accompany design at any level will never replace the people who operate them, consequently design must be simple and user friendly to those who must manipulate the advanced "gadgetry" of the future.

People are the primary concern in OA and the number of workers who are becoming a part of the office environment is growing annually. Figure 3.1 shows the transition that has taken place in the labor force over the past few years. Figure 3.2 reflects the change within white-collar industry. White-collar workers are now the predominant force in the labor market, and yet office procedures are still by and large labor intensive [Ref. 10: p. 37]. This is in part accredited to the fact that businesses have failed to



WHITE-COLLAR WORKERS now predominate in the U.S. economy. The curves show the percentage of the experienced labor force (from 1900 through 1950) and of all employed workers (from 1960 through 1980) that has been accounted for by workers in white-collar jobs (*colored curve*) and by blue-collar workers, service workers and farm workers (*black curve*).

Figure 3.1. Changing Labor Force.

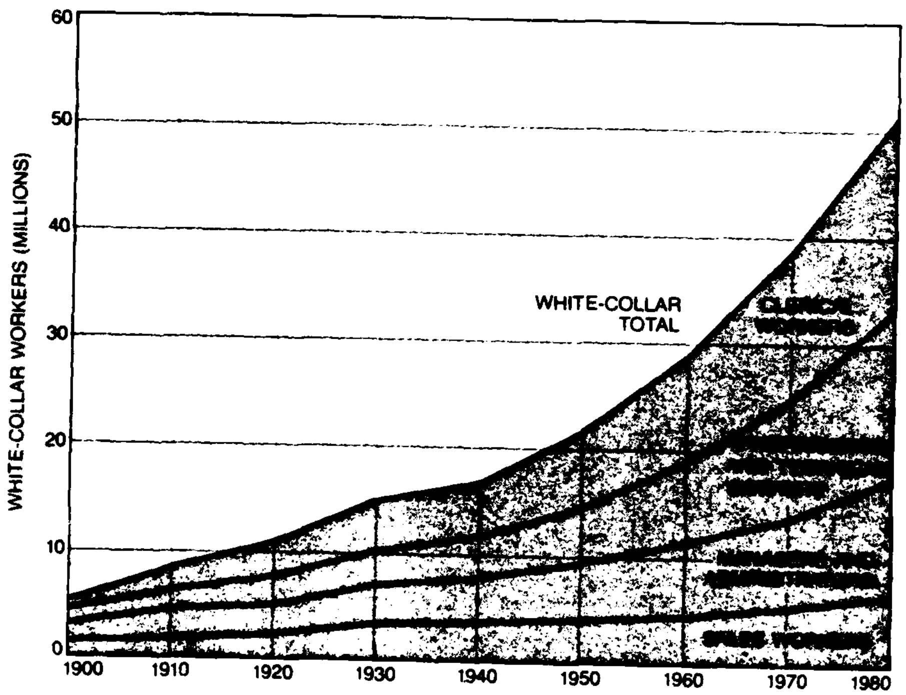


Figure 3.2. Composition of White-Collar Labor Force.

recognize the productivity requirements of the white-collar worker and have thus continued to invest more in blue-collar productivity. In the 1970's, office productivity increased by only about 4% whereas factory productivity rose by 85% [Ref. 10: p. 37]. The differences are attributed directly to management's unbalanced capital investment priorities, contributing $5 - $10 per white-collar worker versus $100 for every blue-collar worker [Ibid: p. 37]. Others estimate that for every $2,500 expended in capital investment per office worker, ten times that amount is spent on factory workers [Ref. 2: p. 178]. Regardless of how these figures are compared, the fact remains that white-collar investment has lagged far behind blue-collar investment and that, combined with the shifting labor market, presents major problems for business in the future.

There are no clearly defined standards or solutions on how to increase white-collar productivity in the years ahead. In fact, there are no well-defined standards as to how productivity in this area was measured in the past. OA is a means of enhancing productivity, but even for OA to realize its promise, manufacturers must reach beyond the secretary to managers and professionals (knowledge workers) who account for 80% of white-collar salaries. To reach this segment of the market it must first understand what knowledge workers do.

The following findings were drawn from over 100 man months of study expended by Booz, Allen, and Hamilton, Inc. (mentioned in Chapter II, Section D) in the area of managerial and professional productivity:

1. Many of the subjects spent less than half their work on activities directly related to their functions.

2. The subjects spend 25% of their work time on less productive activities (i.e., traveling, waiting for meetings, seeking information and expediting assigned tasks, typing, filing, and making reservations and appointments).

3. Meetings in person and by telephone are the commonest form of professional activity.

4. Professionals spend an average of 21% of their work time in document-related activities and only 8% on analysis.

5. Most knowledge workers would like to reshape their time profiles. [Ref. 5: pp. 148-150]

The major conclusions derived from the above study and information are:

1. Fueled by large potential savings in less productive time, the proper application of office support tools can save an average of 15% of knowledge workers time by 1985.

2. Information retrieval, word processing, and character-encoded electronic mail are especially powerful tools, accounting for 65% of the time savings potential through 1985.

3. Newer automated support tools can also significantly enhance the quality of work when incorporated into an overall program of upgrading existing office support resources and improving certain professional practices.

4. For an average business, the annual opportunity of the 1985 time-savings is equivalent to 15% or more of operating income before tax.

5. Business strategy will dictate the form in which this opportunity value is reinvested; therefore, full realization will require thorough top-down planning of the benefits sought and a disciplined program to measure the gains.

6. The winners will be those with top management support who are prepared to commit sizeable people and financial resources to gain an early benefit stream, and who have learned how to manage change.

7. For those who are prepared, significant time savings appear achievable within 18 to 24 months, with a potential payback of opportunity value in slightly over a year. [Ref. 11]

If the benefits recognized above are to become a reality, businesses must commence investing in their professionals. Of $800 billion spent yearly on managers and white-collar professionals, only $30 billion of that – or $1,200 per professional – goes toward information technology. That compares to $5000 for each clerical worker. The recommendations from leading consultants, including Booz, Allen, and Hamilton, Inc., are that businesses must commit an initial investment of $7,500 per professional for equipment, training and installation if they want to stay competitive against changing trends. Such an investment would mean a time savings of $25,000 for each professional over a five year period [Ref. 12: p. 68]. It would also mean less wasted time, higher quality output, and an enhanced quality of worklife.

Helping people to manage information more productively, efficiently and economically is the focus of office automation. There is enough evidence to support the theory

that readily accessible information technology can be an antidote for poor professional and managerial productivity. There is a direct correlation between capital investment and productivity, but if businesses avoid investing in a broadly based program, the electronic office concept will become another overpromised and undelivered remedy full of frustration and expense [Ref. 5: p. 147].

C. PAPER

The generally accepted end product within the office is some form of paperwork – reports, letters, memoranda, copies, files, forms and countless other media of correspondence. Each has some form or variety of life-cycle and some level of associated costs which include purchase, transportation, storage, preparation, completion, revision, signature, envelope placement, addressing, routing, postage reading, copying, forwarding, filing, retrieving, archiving, and disposal [Ref. 4: p. 10]. An approximate figure of what it costs to perfrom the above functions throughout their life-cycle (not including labor) is provided in Table III-1 [Ref. 8: p. 97].

These figures represent an incredible outlay which all too often is useless and unnecessary. It represents a waste not only in monetary terms of lost profits and revenue, but it also implies a loss of natural resources which can never be recouped.

TABLE III-1

COST OF PAPER PRODUCTION

AGENCY	BILLIONS OF $ PER YEAR
Federal Government	55
State and Local Government	12
Private Industry	40
Others (individuals, farmers, labor organizations, associations)	5
Total	112

Under current prevailing conditions man has evolved from master of the written word to slave. He still remains almost entirely dependent on the exchange of "hard copy" paper at a time and in an era of technology where he has the ability to rid himself of the many mundane requirements associated with the administrative entanglements of paperwork. In 20,000 years man has exchanged stone for paper and gone little further. The way he communicates the written word remains basically unchanged.

The case for adopting office automation has never been stronger than this very moment. In 1980, the annual cost to maintain document files was 20 cents per page, including labor, depreciation of file cabinets and cost of floor space. In conservative figures, the cost to obtain and complete the forms in a full file cabinet, up to 18,000 pages, is nearly $25,000. The average cost of maintaining that file cabinet is $3,500 per year, and therefore, in five years of

existence, each innocent looking gray filing cabinet costs approximately $42,300 – and is rising annually [Ref. 13: p. 23]! Additional insight further enhances the case for a better, more efficient, economical mode of handling administrative paperloads.

> "In 1963, records management authority Emmett Leahy estimated that one million pages were being generated in offices every minute of the day: 1.44 billion pages every twenty-four hours, or 525.6 billion pages per year. The 1977 U.S. volume of forms alone (exclusive of photocopiers and documents prepared on plain paper) was set as high as 400 billion pages. Of the total paperwork generated in the United States each year, between 175 billion and 250 billion pages make their way into file cabinets. Furthermore, only 10 to 30 percent of all documents filed are ever again referred to for any reason." [Ref. 4: p. 10]

Donald J. Massaro as President, Office Products Division, Xerox Corporation, once made the comment that the government as the biggest employer of information workers in the country (2.5 million) should lead the nation in finding solutions to the problems of lagging office productivity [Ref. 14]. Unable to resolve this problem, the government has at least reinforced the need for OA. Today there are more than 1000 federal statutes and regulations dealing with record retention and more than 4,700 separate reporting requirements for private enterprises [Ref. 4: p. 10]. This federally created burden provides the perfect scenario for usage of office automation in an effort to better maximize the way information is stored, manipulated, retrieved, and reported within organizational structures.

The final approach in this section takes a hard look at costs associated with producing one page of typewritten material. At 1979 wage levels, it cost American businesses approximately 3 cents to research and write each word or number in the average report. Within the federal government one agency estimated its costs at $3.36 per word or number. The wide spectrum between these two figures equate out to a range of $17 - $2000 per page [Ref. 4: p. 10], a cost which can be ill afforded by businesses generating literally billions of pages annually. The other alternative demands utilizing the current technologies available through office automation. As emphasized in the previous section, the harsh reality is that capital investitures must be made to offset the rising costs associated with white-collar productivity. Electronic mail, information storage and retrieval and word processing are not gimmicks of the future, they are methods of survival for today.

D. PRODUCTS

Chapter V deals specifically with the types of products and technologies that are available through office automation and how they are utilized. The intent throughout this section is to briefly illustrate the growing product market demanded by OA.

Offices are being automated and certainly there is a great need for continued automation, but there still doesn't exist the great demand that observers predicted a few

years ago. There are three principal reasons for this: a sluggish economy, uncertainty about what OA comprises, and buyer's doubts about whether they will see a return on investment [Ref. 15: p. 126].

The sluggish economy is cyclic and unquestionably has detained many organizations from investment, but that doesn't imply that sales of office equipment are static or falling off. On the contrary, market researchers are predicting enormous growth in sales of office technology over the next 5 - 10 years. One manufacturer, International Data Corporation, has estimated expenditures of $180 billion in OA equipment during the five year period ending in 1986. Another firm, International Resources Development Inc., predicts annual expenditures of $36 billion by 1990, which is three times the current sales [Ref. 15: p. 126]. Still another prediction estimates that U.S. shipments of gear that can be linked to form electronic offices will grow at a rate of 34% annually through 1986 [Ref. 2: p. 184]. Additionally, in 1981 vendors buttressed sales efforts with over $33 million in advertising for components of OA. From the vendors perspective, OA is there not only to enhance business but to creat business.

Uncertainty about what OA really is obviously remains a stumbling block for many investors. Because of its broad utility and potential, OA remains a mystery which is unravelling only through continued application and

evolving technologies. As stated in Chapter 2, office automation is the combination of many innovations, office systems, and technologies. This makes it nearly undefinable to the corporate executive who finds it difficult to justify investitures into such a nebulous arena. Additionally, with technology advancing in quantum leaps and bounds there is a real hesitancy to invest "now" for fear that next year's line of equipment will make this year's investment antiquated.

As time and technology advance, permitting more knowledgeable and standardized systems, these fears should dissipate somewhat, leaving a more precise definition of OA. The hazy and distorted picture now presented to management should clear as more and more systems are implemented, leaving more definitive answers for those skeptics.

Because of the intangible benefits associated with implementing OA such as improved decision making, enhanced span of control, minimized drudgery and better use of time, there will always be room for doubt whether the technology is, in fact, paying for itself. The standard acceptance of recognizing returns on investment via a balance sheet doesn't show the true return on OA, and since there have been no truly reliable means of measurement for office productivity in the past, there is no way to measure how much these intangibles enhance or distract from productivity. However, if one recognizes the value of such studies as those done by Booz, Allen, and Hamilton, then there is evidence which

clearly supports a case for automating the office. If the high-technology of OA enhances the knowledge worker by providing him with additional time for creative work and minimizes the time and drudgery for the clerical worker, then the benefits represent a significant return which can be clearly measured in business terms. These include reduced head counts, increased volume, higher margins, improved resource utilization, faster turnaround, fewer errors, improved customer services and new capabilities [Ref. 16].

E. MANAGEMENT

The true potential for office automation is to reach beyond the secretary to management and professionals who account for 80% of white-collar salaries. In 1980, approximately 60% of the $1.3 trillion paid out for wages, salaries and benefits in the U.S. went to office workers [Ref. 2: p. 176]. Of that amount, over $600 billion went to compensate knowledge workers, and yet, by 1985 it is predicted that only 6% of managers and professionals will be using sophisticated work stations [Ref. 5: p. 147].

The undeniable preponderance of evidence from the studies previously cited shows that management stands to gain most from OA. There must be a way of enhancing the knowledge worker's productivity in the years ahead. The 1970's saw an 85% increase in industrial productivity weighed against a 4% gain in office productivity; a totally unacceptable measurement in terms of the shifting labor market [Ref. 17].

To reach the fifth and sixth levels of office automation discussed in Chapter 2, to provide the knowledge worker with the tools necessary to enhance his productivity and increase his efficiency and effectiveness, organizations must make major changes accommodating the upper echelons of management in their decision making processes. Of primary importance is management support and involvement, starting at the top. For those companies which have already obtained this support and implemented OA systems, (e.g., American Express, Lincoln National Life, Merrill Lynch, and Northwest Industries), the benefits derived have already paid for the costs incurred [Ref. 2: p. 189-190].

The second major step is to increase capital investment on those who need it most - the knowledge workers. OA technology does not come cheap, but as mentioned over and over again, the returns on investment are immense. If 15% of a manager's time can be utilized for more productive, creative work, the investment has been wisely made. However, if an additional 30% can be reduced on administrative costs and another 26% on personnel costs, and communications enhanced for all (which are all within the potential scope of OA), then the investment is not only successful and profitable, it's revolutionary!

The third major change must be realized through continued and advanced training and education of all personnel, managerial and clerical alike, from the president to

receptionist, in the applications and benefits of OA. A system without maximum capacity utilization, that is, without employing all the technological attributes of the system's design, is money lost. To benefit from the system and to realize its full potential, all concerned must know and be familiar with how it can best be employed to meet the day-to-day demands of managerial and clerical activities, how it impacts on planning (short term and long term), how it affects their job, and how it influences the overall strategic environment of the organization. The final point is understanding that automating the office is neither an end-all nor a placebo, but a tool for a new beginning towards better and more sophisticated ways of handling information and enhancing human productivity.

IV. INFORMATION AND COMMUNICATIONS

A. GENERAL

From earlier chapters we have determined what office automation is and the vital need for continued application, development and implementation of OA systems. This chapter takes a quick overview of the types of information that are handled by OA and the types of communication technologies that tie electronic offices together.

B. INFORMATION

Webster defines information as

> "a signal (as one of the digits in dialing a telephone number) purposely impressed upon the input of a communication system or a calculating machine." [Ref. 18: p. 443]

Another descriptive version of information cites it as being

> "(1) data that has been transformed into a meaningful and useful form for specific human beings; (2) the meaning that a human assigns to data by means of the known conventions used in their representation." [Ref. 19: p. 575]

Combined, these two definitions most appropriately describe information in the context – text, data, voice, and image – that applies to office automation. In one sense of the word, data, which is a representation of facts, concepts, or instructions, are the medium for input into a communications system which can then be transferred from one person or machine to another (the system being humans or machinery).

How this data is perceived, either in audio, written, or visual form and how it is interpreted determines whether the data becomes information. The representative translation of data into useable form, either by humans or machines, is referred to as information.

In office automation there are several forms of information which are handled by different technologies and products that allow data to be communicated. The first of these is text, generally implied to mean written or printed words. The second form is data, which implies a different meaning than that just presented, but which is generally accepted to mean numbers or numerical representations. Voice is the third medium of information and alludes to the spoken word. The final form relates to the visual impression of either image or graphics in some pictorial representation. These four main groups comprise the primary media by which information is disseminated from one person to another. The transfer of this information is referred to as communications.

C. COMMUNICATIONS

Communications, or the transfer of information, is the heart of office automation. Without advanced communication technologies the electronic office, comprised of numerous products which facilitate the transfer of information from person to person and point to point, could never have evolved. Therefore, before discussing the various forms of equipment

and technologies of OA in Chapter 5, it is necessary to preview some basic principles and terminology inherent in the transfer of information.

D. TERMINOLOGY

The following is a list of terms most often associated with the description of communications technology and office automation products.

Telecommunications - the use of telephone, teletypewriting, telegraph, radio or television to transmit information directly or via computer.

Baud - a baud is a unit of signaling speed and refers to the number of times the state (elements) of a line changes per second.

Narrowband - voice grade communication channels with a bandwidth of 300-3400 hertz.

Broadband - image or graphic communication channels with a bandwidth of up to 300 megahertz.

Data communications - the transfer of data between computer-related devices.

Electronic communications - the combination of telecommunications and data communications.

Analog signals - consists of continuous but variable electrical waves.

Digital signals - consists of discrete electronic units transmitted in rapid succession.

Protocols - technical customs or guidelines that govern the exchange of signal transmission and reception between equipment.

Asynchronous transmission - each character is transmitted separately. The character is preceded by a start bit, which tells the receiving device where the character coding begins, and is followed by a stop bit, which tells the receiving device where the character coding ends.

Synchronous transmission - characters are transmitted as groups, preceded and followed by control characters. The transmission and receiving intervals between each bit are precisely timed permitting grouping of bits into identifiable characters.

E. PRINCIPLES OF TRANSMISSION

The following descriptions are various forms of communication transmissions employed by office automation equipment. One or more of these forms must be utilized in the transfer of data between equipment nodes. Additionally, these links must perform transmission in one of three ways. The first, referred to as simplex, means that transmission is one-directional only. A half-duplex system allows sequential transmission of data in both directions but involves a delay when the direction is reversed. The ability to transmit simultaneously in both directions requires a duplex or full-duplex system.

Communication carriers in the U.S. are licensed by the Federal Communication Commission (FCC), which regulates public transmission by wire, radio, satellite, telephone, telegraph, facsimile and telephoto. There are over 2000 telecommunications carriers in the U.S.. Additonally, there are specialized common carriers, such as MCI and SPRINT, that provide specific communication services for heavy traffic areas such as large cities.

1. Modems

Modems are used in data communications to help transmit data between computers and terminal devices. They transform (modulate) digital data from a computer terminal to analog form, which is more suitable for communication transmission. They are also able to accept analog signals and restore (demodulate) them back to original digital form. Thus the word modem is derived from the modulation-demodulation process performed. Different types of modems permit synchronous or asynchronous transmission, operations over dedicated or dial-up lines, and simplex, half-duplex or full-duplex operations. They may function over unlimited distances (referred to as long haul) or they may be restricted to limited distances (short haul) of 50 miles or less.

2. Acoustic Couplers

An acoustic coupler is a modem in which the coupling between a computer processor or terminal device and the communication line (generally implied to mean telephone line)

is acoustic (operated by sound waves) rather than electric. The output of an acoustic coupler is an audible sound which is applied directly to the telephone mouthpiece. In the reverse direction, the telephone earpiece is applied to a microphone in the modem which is also the limiting factor of the data speed.

3. Optical Fiber Transmission

Optical fibers can transmit pulses of information in the form of laser-emitted light waves. The light waves are detected and decoded by a receiver through the use of photo diodes. The transmitting media is glass fiber that is thinner than human hair, stronger than steel and 80 times lighter than equivalent copper wire. Its capacity is one billion times the capacity of copper telephone wire in bits per second [Ref. 19: p. 111]. Furthermore, optical fibers are basically unaffected by electromagnetic interference and are thus highly secure.

4. Infrared Transmission

Optical in nature, infrared transmissions are carried by beams of light invisible to the naked eye. It has limited distances of a few hundred feet which make it useful only between buildings within the same general area and within line-of-sight. It is compact, inexpensive and moderately secure [Ref. 4: p. 39].

5. <u>Laser Transmission</u>

Providing a high degree of security, communications lasers are narrowly focused beams of light which like infrared transmissions are invisible to the naked eye. They rely on extremely sensitive receiving equipment which is marketed in narrowband and broadband versions.

6. <u>Satellite Transmission</u>

Satellite transmission, another line-of-sight mode of communication, implies some form of relay station whereby a signal from one earth station is received, amplified and transmitted to another station. They are capable of handling data transmission, audio transmission, and full color, television transmission. Security for satellite transmission is generally considered vulnerable since anyone with the proper equipment can access the signals. However, through coding and decoding equipment some level of security can be obtained.

7. <u>Radio Transmission</u>

Radio transmissions are governed by the Federal Communication Commission which allocates radio frequencies for direct voice communications, prohibiting data transmissions. There are two basic types of radio licenses. Class A type licenses are used by taxicabs and delivery type vehicles on a single assigned frequency. Class D type licenses are granted to citizen band radio operations which permit flexible as well as mobile communications. Security for this form of communication is nearly nonexistent.

8. Wired Transmission

The last form of transmission media discussed in this chapter is hard wired transmission. As well as being the most common form it is perhaps the most versatile. Hard-wired transmission implies that two or more devices are connected directly by wiring, e.g., twisted pair or coaxial cable. They may be either narrowband analog or in special cases, broadband analog and digital circuits. Security is, again in this case, almost nonexistent.

V. TOOLS OF TECHNOLOGY

A. GENERAL

The previous chapter provided a brief synopsis of the types of information that are prevalent in an electronic office as well as the various forms of communication links which bind OA systems together. It must be kept in mind that without the communications aspect even the best of equipment to be discussed in this chapter is of little value.

Because no two office systems are alike or meet the needs of every organization, there is a great deal of variety and flexibility as to which technologies and equipment configurations can compose an automated office.[1] Continued improvements of existing equipment combined with new product lines further cloud the issue of which technologies are best suited to specific applications. There are no right answers as to which of these configurations an organization should employ. What is significant, as will be discussed in Chapter 6, is that the equipment selected

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[1]A great deal of material has been written concerning each of the areas that will be discussed and therefore could be explored and expanded upon far beyond the levels presented herein. Use of the bibliography for advanced research is highly recommended.

should be well planned and thought out, that it allows for expansion, and that it subscribes not only to the immediate needs of those who utilize it, but that it is consistent with the overall planning and strategic goals of the organization concerned.

B. WORD PROCESSING

The most widely discussed area of office automation throughout the last 10 - 15 years has been word processing which was represented by the first and second levels of the pyramid discussed in Chapter II. A quick distinction is necessary for clarification of this subject area. Word processing, as a function, is a type of automation technology. The word processor, as a unit, is a device which handles and performs word processing services. The term word processing was an IBM invention in 1964 as a way to market a typewriter which could record words on magnetic tape [Ref. 20: p. 1573].

There are a large variety of word processors available on the market today offering a multitude of features which include global search and replace, sort, move, copy, insert, deletion, math, records processing, programmability, communications, spelling check and mailing lists. Generically, they consist principally of keyboard, display unit, a computer, and one or more removable storage devices in the form of disks, diskettes, tape units, or magnetic cards.

Word processors are designed to simplify the production of documents by eliminating the repetitive tasks of typing, editing, and outputting. Additionally, many word processors offer extensive formatting capabilities and some limited data processing applications. They are most useful in the production of documents that are heavily revised, frequently reissued after initial distribution, forms-oriented, and lengthy documents that require extensive editing.

The various forms of word processors include stand-alone systems, shared-resource systems, shared/distributed logic systems, cluster systems, and software packages for mainframe or micro-computers [Ref. 21: p. 24]. A stand-alone system consists of a single, self-contained terminal housing the operating system, the software package and the disk file. It is entirely independent and does not rely on a central processor for its functionality nor does it share any functionality with any other system.

Shared-resource systems are essentially stand-alone systems sharing peripheral devices such as printers, which can be expensive and may represent a large portion of the individual stand-alone purchase price or the total cost of shared-logic system. A shared/distributed logic system shares software, files, logic, workstations, and printers with all the attached terminals. It can handle concurrent data and text processing, massive on-line storage, programmability, and even development of a text data base.

Advantages of the shared/distributed logic system include more on-line storage, more sophisticated software, superior functionality, job sharing, minimal media handling, and standardization. The major disadvantage is its vulnerability to total breakdown, that is if the central processor goes down, all terminals become inactive.

A cluster system combines stand-alone, shared-resource, and shared-logic system technology offering flexibility and access to both files and resources. Advantages of this configuration include excellent growth and expansion capabilities as well as inclusion as part of local-area networks, which may include several kinds of workstations attached to one central processing unit, electronic file cabinets, printers, and so on. Disadvantages are primarily standardization and degradation of response time.

Software packages are available for installation on mainframe computers as well as micro and personal computers. Basically code intensive and less functional than dedicated word processors, software packages are best suited for applications requiring minimal word processing.

Other applications of word processors permit the handling of large documents of more than 125 pages which are sometimes referred to as document processors. In the advertising industry a word processor with graphic capabilities may be used to create total composition of individual pages, including text manipulation, electronic cropping, and

placement of graphics and halftones within text. Word processing terminals when installed with communications packages may also be used for electronic mail. Phototypesetting and photocomposition are also within the capabilities of word processors as well as the employment of Optical Character Readers.

C. ELECTRONIC MAIL

Electronic mail is primarily a medium of internal communication within a company capable of conveying audio, data, text, graphics, or hybrid modes of information between users [Ref. 22: p. 48]. It can be anything from two telephones to one of the many advanced computerized message systems currently being marketed. It can extend externally from the office to almost any location in the world. Communication may be synchronous or asynchronous, computerized or noncomputerized, and may consist of single node or multinode configurations.

Undoubtedly, electronic mail has rapidly become one of the most important and widely used tools in office automation growing from approximately 5,000 terminals in 1978 to over 80,000 at the close of 1981 [Ref. 23: p. 85]. Today, not only do more than 70% of the Fortune 500 companies use electronic mail [Ref. 24: p. 54], but it has expanded to an over $3 billion a year market [Ref. 8: p. 54]. By 1986 it is expected that electronic mail will be in use in over

40% of all the medium size to large companies throughout the United States.

A rival to more traditional forms of messaging, electronic mail has many uses which include improved access to personnel, improved information flows, elimination of "telephone tag", scheduling appointments (for individuals, groups, rooms, equipment, and even vehicles), executive calendars, ticklers, virtual meetings and a host of other benefits which are listed below:

- Improved productivity
- Improved management control
- Improved coordination of group activities
  Rapid transmission of messages to individuals or groups
  Rapid, paperless forwarding of messages
- Shortened messages and reading times
- Automatic records of messages
- Nonsynchronous communications
  Around-the-clock messaging
  Time-zone and geographic transparency
  Remote access
- Reduction of paperwork and paper handling
- Reduction in volume of photocopying
- Reduction in labor and transport when moving offices
- Efficient automated file searching and retrieval
- Elimination of misplaced or lost documents
- Delivery impervious to weather conditions and holidays
- Powerful manipulative options from primary operation in electronic and magnetic media

- Improvement of time management
  - Elimination of no-contact telephone calls (telephone tag)
  - Reduction in managerial interruptions
- Improved corporate image
- Enhanced management capabilities

The most important aspect of electronic mail is its messaging system which serves as an electronic substitute for the traditional office procedures such as typing, photocopying, envelope addressing, filing, retrieving, etc. Additionally, computer-based message systems act somewhat like telephone answering services in that they retain messages from senders in computerized files and permit users to receive messages on their terminals at their convenience and from any location. The three primary functions of computer-based messaging systems are creation, storage, and receipt of messages.

There are many forms of technologies closely associated with electronic mail including facsimile, viewdata, time-shared message-switching networks, communicating word processing equipment, teleconferencing, text and data handling, image services, and voice mail. Among the networks mentioned above there are many private and commercial networks available which through the use of standard protocols permit hundreds of different computers and electronic mail interfaces to exchange information. Several of the better known networks are listed below in Table V-1.

TABLE V-1

NETWORKS

NETWORK	USER/MANUFACTURER
ARPANET	Department of Defense
COMET	Computer Corp. of America
INFOMAIL	BBN Information Management Corp.
INTERCOMM	Dialcom
ONTYME-II	Tymnet
TELENET	GTE
XEROX 8000	Xerox Corp.
ARC	Datapoint
PRIMENET	Prime Computer
MAILWAY	Wang Laboratories
ECOM	RCA
INFOPLEX	Compuserve
MAILBOX	STSC
MAILCALL	The Source

D. VOICE MAIL

Voice mail is one of the newcomers in office automation technologies. Based on a communication system that has been around for a hundred years - the telephone, it incorporates the use of voice transmission while utilizing the same basic characteristics of electronic mail and telephone answering machines. Voice mail is a computer-based system

for recording and transmitting voice messages. The message is spoken using a telephone set and stored in digital form for later forwarding to one or more recipients [Ref. 25: p. 13].

The basic configuration of a voice mail system includes a minicomputer, large disk drives, communication ports that can recognize Touch Tone signals, a digitizer that will convert analog voice to digital bit streams, and a device that will enable the bit streams to be returned to analog form for playback. Designed primarily as stand-alone units for the present, voice mail systems are integrated into the telephone system via a private branch exchange [Ref. 25: p. 16].

Because voice-recognition and voice-response are relatively new forms of technologies in OA, there remains a great deal of latitude for improvement and continued research. Voice controlled terminals used for the same purposes as text editing terminals require that the devices be trained to recognize the users speech. While this provides increased security it is a time consuming and laborious task. Voice-response creates audible responses by some stimulus such as entering code into a computer through a terminal keyboard or telephone keypad. Sounds are produced via magnetic recordings or solid state technology. A third form of voice technology is referred to as a voice synthesizer which operates on sounds

called phonemes. Voice-response units utilizing phonemes have unlimited vocabularies, and if correctly programmed, can be read directly from text files and converted into audible sounds [Ref. 4: p. 176]. The major problems with voice apparatus are limited vocabularies and an inability to deal with continuous speech.

Besides the basic capabilities of recording, editing and sending, voice mail has some other features particularly suitable for OA. Some of these options require passwords for security and authentication, some have message delivery lights to indicate a message has been left, basic dictation capabilities, reminders for future deliveries, voice-response units to retrieve messages when detached from terminals, and voice calendars and ticklers.

Like its counter part (electronic mail), voice mail eliminates telephone tag and interruptions thereby reducing incomplete information exchanges or late/lost opportunities. Not only is it cost effective and highly productive, but it reduces much of the unproductive social exchanges experienced in normal telephone calls. It has the capability of sending messages to one or more recipients as well as predefined groups just as in electronic mail [Ref. 26].

As the technology increases, the benefits and applications of voice mail will also be enhanced. For the time being, voice mail is restricted to the uses defined above. However, experimentation has been done and even though

voice mail is considered in its infancy, there are voice packages available for VisiCalc, WordStar and for writing BASIC programs for almost any occasion [Ref. 27: p. 58].

E. TELECONFERENCING

Teleconferencing is perhaps one of the oldest forms of automation technologies effecting office automation, having existed since the days of the telegraph and the telephone. Teleconferencing is the use of telecommunication systems to enable a group of three or more people, at two or more locations, to confer with one another [Ref. 28: p. 251]. Obviously, there are numerous means by which such communication can be performed and different authors break them down in a variety of ways. For our purposes here, only three forms will be addressed – audioconferencing, videoconferencing, and computerconferencing.

The many variations of teleconferencing provide for a wide span of applications. The major application is in the area of administrative conferences held for business oriented purposes. These include staff meetings, sales presentations, press conferences, etc. Other applications include telemedicine, conducting medical diagnoses and treatment with the patient at one location and the physician or specialist at another. The University of Wisconsin uses teleteaching at over 200 locations throughout the world to reach over 30,000 students annually.

Teleservicing is much like telemedicine but is directed toward equipment repair and maintenance [Ref. 4: p. 138]. The types of applications inherently possible with teleconferencing are infinite, limited only by the technological capabilities to send and receive transmitted data. Table V-2 provides possible additional applications especially suited for teleconferencing.

TABLE V-2

TELECONFERENCING APPLICATIONS

Announcements	Medical diagnoses
Brainstorming	Negotiations
Briefings	Press conferences
Budget reviews	Problem solving
Contract negotiatons	Product introductions
Coordination	Production forecasts
Employment interviews	Quick approvals
Engineering changes	Resolving conflicts
Failure analysis	Reviews/updates
Goal setting	Staff meetings
Interactive information exchanges	Teaching
Interim discussions and understanding	Trip planning
Technical exchanges	Trip reports

As in all forms of OA there are a multitude of benefits to be derived from the implementation of technology. Benefits of teleconferencing include: [Ref. 4: p. 138]

- Improved productivity
- More effective use of time
- Reduced labor costs
- Reduced travel costs
- Ability to attend several meetings at diverse locations in a single day
- Quicker solutions to problems
- Short reaction time

Some of the most persuasive reasons for implementing teleconferencing are environmental factors. Not only can travel costs be reduced but it has been estimated that:

> "...for each one percent reduction in urban automobile traffic brought about by conversion to video teleconferencing, a reduction in urban air pollution of approximately 0.8 percent would result." [Ref. 29]

Additionally, Barcomb states that

> "Only about 30 percent of business meetings require face-to-face contact, yet 40 percent of all U.S. air travel is for business purposes; that travel consumes 250,000 barrels of jet fuel daily. U.S. business travel by automobile consumes 400,000 barrels of gasoline per day. Replacing only 20% of U.S. business travel with teleconferencing could save 33 million barrels of fuel annually. Federal energy studies indicate that use of teleconferencing could reduce the country's annual petroleum consumption as much as 5 percent." [Ref. 4: p. 138]

The point here is that teleconferencing alone will not reduce business travel or necessarily save the environment from destruction. However, it is reasonable to presume

that teleconferencing, like many other OA technologies, provides organizations with the tools to reduce unnecessary expenses and to improve organizational performance and effectiveness. The use of technology to improve human productivity in the office may thus lead not only to a more productive organization but to a more productive society as well.

1. Audioconferencing

In the form of the conventional telephone conference call, audioconferencing is almost as old as telephony. It is concurrent in nature requiring all participants regardless of location to take part simultaneously. Audioconferencing may be enhanced with some graphics through the use of computer terminals, but they too must be simultaneous.

Audioconferencing is the simplest, least expensive and most universal form of teleconferencing. From a users point of view, the most obvious features of an audio-conferencing system are the room in which one participates, the audio equipment, and when augmented with graphics such equipment as facsimile, two-way electronic blackboards, and freeze-frame or slow-scan video [Ref. 30]. Less apparent features are the transmission system and conference bridge.

There are three types of transmission systems – the message telephone system which is entirely dedicated to the system in question, private networks used for both audio-conferencing and other traffic, and private transmission

facilities which are not dedicated to audioconferencing alone. A conference bridge is necessary whenever two or more locations are used, and is used to interconnect the transmission circuits from each location [Ref. 28: pp. 262-270].

2. Videoconferencing

Videoconferencing is much more complex and expensive than audioconferencing but offers a great deal more in terms of user interaction and participation. Touted as a means to reduce high costs of travel and a way to increase managerial productivity, videoconferencing provides a means for personal communication through face-to-face meetings, verbal communications through the use of the telephone, and visual communications through written format such as letters and memos [Ref. 31: p. 11].

There are three forms of videoconferencing all of which are synchronous in nature. Full-motion, one-way video is suited primarily for one-way communications. Such conferences are suitable for meetings where basic information is being represented to attendees in remote locations and where complete interaction is not necessary. Full-motion one-way video, two-way audio is the most widely used form of videoconferencing. It is best suited for group conferences at remote sites where the ability for audio interaction is of prime importance. The third form, full-motion two-way video, two-way audio is the most complete

videoconferencing system. It provides for complete visual and audio interaction by the participants and is the closest thing to face-to-face meetings. The most expensive form of videoconferencing in terms of equipment and operation, it still provides significant costs savings when conpared to travel expenses [Ref. 31: p. 12].

The most obvious features of a videoconferencing system are the room, projection equipment, and large screens for viewing. Transmission systems are satellite communication services and cable television. The costs for videoconferencing depend on the number of components required which include preproduction setup, television production, length of broadcast, site of program origination, interactive audio system, number of receiving locations, projection equipment for viewing, and meeting room facilities.

In addition to benefits derived from reduced travel costs (potentially 20%), videoconferencing offers several other subtle advantages. Because time is limited people come to videoconferences better prepared and have a tendency to be more considerate of the speakers. Participants feel they have a better chance to be heard than in face-to-face meetings where they may feel intimidated. There are fewer distractions in videoconferences making it ideal for technical discussions and presentations. Management spends less time traveling and more time in

productive work. Because meetings can be scheduled more often without major disturbances in individual schedules, participants can keep better informed of corporate activities.

The following conclusions are supported by another Booz, Allen, and Hamilton, Inc., survey conducted on teleconferencing users of 10 major companies:[2] [Ref. 32: p. 95]

- Three-fourths of the respondents perceived an increase in personal productivity.
- Half reported increased meeting effectiveness.
- Half perceived a decrease in time needed to make decisions.
- One-third reported an increase in decision quality.
- Three-fourths experienced a decrease in travel expenses, while an equal number spent less time away from their home offices.
- Half increased the amount of communications among various parts of their organizations.
- Ninty percent of the users were "satisfied" or "very satisfied" with their teleconferencing usage.

3. Computerconferencing

Computerconferencing, which is very similar to electronic mail[3], permits participants to conduct meetings

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[2]Companies included in the survey were Deere and Company, Exxon Research and Engineering Company, Hughes Aircraft Company, IBM, Liberty Mutual Insurance Company, M/A-Com, Proctor and Gamble, Sperry Univac, and Aetna Life and Casualty.

[3]Some authors and consultants advocate electronic mail to be a subset of computerconferencing.

with personnel throughout widely scattered geographic locations. Utilizing communications networks, conferees can access, read, and respond with other participants regardless of whether the others are communicating simultaneously or not. Users communicate indirectly through the computer files that they jointly create with the host system software keeping track of who has what material.

Because computerconferencing does not have to be concurrent and ongoing users are not tied to any specific time schedule, unlike traditional correspondence, computerconferencing provides an ongoing electronic filing system for systematic and rapid retrieval. Notes or memos can be sent to other conferees or to a group. The system provides for on-line bulletin boards, management and user reports, directories, on-line newsletters and journals, status and tracking functions, and electronic mail.

The advantages of computerconferencing aside from those mentioned above, compare with other teleconferencing technologies mentioned previously and closely parallel those mentioned in electronic mail. Advantages associated with computerconferencing include:

- No time restrictions. No one is ever late for a meeting; no more telephone tag.
- No geographical restrictions. The system is always there.
- Lowest cost of teleconferencing technologies.

- Self-documenting and filing. The system serves as an electronic desk.

- No acting or performing skills required.

- Allows time for thought in work and management.

- Self-paced training.

- Users can participate in many conferences in a day. Waiting at the airport is eliminated. [Ref. 33: p. 5]

F. FACSIMILE

Although the origin of facsimile can be traced back to the 1840's it was not until the 1920's that AT&T, Western Union and RCA put it to serious use in transmitting photographs, telegrams, and weather maps. In the 1960's facsimile began to develop a general purpose market among business users [Ref. 34: pp. 1-2].

Facsimile simply implies copying at a distance. It is a method of transmitting original handwritten or printed documents or graphic representations electronically to a distant location using a telephone network or other means of transmission. It can be synchronous or asynchronous, half-duplex or full-duplex, and computerized or noncomputerized. Facsimile operates by scanning documents or graphic representations and then remotely recreating the images in terms of vertical lines and pixels per inch. (Speed and resolution being the prime areas of importance.)

Facsimile may be implemented in either analog or digital form. In analog form a scanning spot passes over each line

producing a continuous wave whose amplitude represents lightness and darkness. The wave is sent to a receiver whose writing element deposits pigment corresponding to the ups and downs of the wave. In digital form the scanner subdivides each line into small cells assigning a number description of its lightness and darkness. A processed version of this sequence is then transmitted to a receiver which has a non-impact printer or writing device to reproduce the light and dark signals thereby reconstructing the document [Ref. 35: p. 126]. Because uncompressed facsimile encoding of a single letter size page normally require two million bits of information, most digital systems incorporate some compression technology which reduces the encoding to about 200,000 - 300,000 bits per page [Ref. 4: p. 98]. Additionally, increased use of facsimile over long distances and for intercompany communications has led to the emergence of facsimile communications networks [Ref. 34: p. 10].

Extended forms of facsimile include glass facsimile which is a store-and-forward system by which graphic documents may be stored within users' files for subsequent redisplay. Display of this system is on special, high resolution terminal screens. A combination of text/graphic systems commingle encoded textual data and graphic images. Merged text facsimile systems overlay text within individual facsimile images by means of a keyboard terminal used with a transmitter. Output is via a hard copy receiver. Another

form, hybrid text, inputs text through a keyboard terminal and produces hard copy output. Specialized software converts encoded characters into graphic format which the facsimile output unit then reproduces. An additional facsimile technology called microfacsimile incorporates the marriage of micrographics and facsimile by sending microfiche or roll film images over telephone lines [Ref. 36: p. 62].

As in other forms of automation equipment there are the advantages and benefits which make this type of technology appealing. Below is a list of those associated with facsimile.

- No retyping eliminates both the chance of introducing errors and any retyping cost.
- It can transmit graphics such as signatures.
- Simple operation virtually eliminating training.
- It is extremely fast.
- Highly flexible.
- Accurate reproductions.
- Portable.
- Can provide secure transmission through added enhancements.
- Better channel utilization over dial networks.
- Protects from signal distortion by phone line (digital).
- Fits general trend toward digitizing communications (digital).
- Provides an alternative to mail.

G. PRIVATE BRANCH EXCHANGES

Private telephone-based systems described as PBX's (Private Branch Exchanges), PABX's (Private Automated Branch Exchanges), EPABX's (Electronic Private Automated Branch Exchanges), or CBX's (Computerized Branch Exchanges) are perhaps the fastest growing tools in office technology. The reason for this quick growth and wide spread interest is that newly developed digital PBX's can switch voice and data simultaneously, making them practical as local switches for slow speed data services as opposed to merely voice traffic controllers.

Up until recently corporate communications environments have been typically telephone networks that supported in-house and external calls by means of an analog PBX. With the introduction of a digital PBX, the communications environment has shifted toward integration of voice and data including services such as facsimile, videoconferencing, and communication word processors. This integrated network approach provides 3 primary benefits: it can adapt more easily to new technology and applications, it provides a uniform way of dealing with total corporate communications requirements, and it can result in significant savings through economies of scale [Ref. 37: p. 41-42].

The impact of digital PBX's significantly changes the structure of many office automation plans. Local area

networks which are characterized by a broad bandwidth, low error rate, strong connectivity, and multimedia interfacing were once considered the best approach to link offices together. With the introduction of the digital PBX the best approach now appears to be a combination of the two with the PBX interfacing directly with the local area network to provide a communications link between telephone stations and other devices [Ref. 38: p. 74]. Eventually the PBX will connect huge numbers of terminals and equipment that transfer data primarily at slow speeds. The local area network, on the other hand, will handle the high speed data transmissions between computers [Ref. 39: p. 144].

A PBX is composed of four main elements: the computer, which controls the switching network that connects PBX stations and trunks; the memory, which holds frequently used instructions; the interface and auxilliary equipment for translating CPU instructions to the switching network; and the switching network which performs the protocol conversions and switching capabilities between lines [Ref. 40: pp. 83-88].

PBX's support the following advantages:

- Cheaper because it utilizes telephone lines as opposed to coaxial cables.

- Consistent in that it provides for all internal communications to remain digital.

- They are flexible, controlling up to 20,000 voice lines.

- Highly reliable with uptimes of 99.9%.

- Extremely portable.

- Highly functional and capable of:
  Packet switching
  Circuit switching

- Supports large numbers of devices.

- Produces little time delays.

- Transparent to users.

- Offers facsimile.

- Offers slow-scan and real-time video. [Ref. 41]

Future applications suggest a continued trend towards distributed processing incorporating voice store and forwarding, electronic/voice mail systems, text messaging, and advanced directory services (forms of automated telephone dialing).

H. ELECTRONIC FILING AND INFORMATION RETRIEVAL

At the heart of every office are the recorded archives of data and information filed away for future reference. Currently, these consist of hard-copy paper files, and in cases where OA technology has already begun, soft-copy electronic files. The problem with either is that there must be some way to retrieve the information that has been stored. Electronic filing and retrieving presents the fastest and most accurate means of solving that problem.

Electronic filing systems include both automatic file searching and retrieval tools. The system can be either closed loop, in which the information and the location have been electronically encoded, or it may be an open loop, in

which case the location has been electronically encoded but the information has not. By entering one or more specifications in a computerized system the user may gain direct access to the information, or if the system is an open loop, the user will be given the source and location of the information.

The only real disadvantage to electronic filing and retrieval is that the user must have access to a computer terminal. The advantages are:

- Faster access to information.
- Reduction in misfiling.
- Reduction in amount of office floor space.
- Storage efficiency through shared access.
- Portability of files.
- Time transparency for access.
- Geographic transparency for access.
- Limited knowledge of filing techniques [Ref. 4: p. 105]

Virtually all forms of OA equipment, word processors, computer-based message systems, electronic calendars and tickler files, micrographic units, and integrated office systems must file and retrieve files of information. Access capabilities usually provide for several methods of search, e.g., authors name, specific dates, inclusive dates, key words, or message numbers. Through the use of such data-based systems users who are unsure of exactly how information may be defined have the ability to search files via several different possible subject parameters.

Other forms of electronic filing and retrieval systems include the use of micrographics, microfacsimile and internal and commerical data banks with vast libraries of information stored in central computers. Such banks cover information and data on a variety of subjects such as agriculture, demographics, economics, education, environment, government, international affairs, laws, patents, and science [Ref. 4: p. 109].

I. OPTICAL CHARACTER READERS

Optical Character Recognition (OCR) may be defined as the high-speed process of converting machine (i.e., typewritten or printed) or handprinted numerals, letters, and symbols into computer-processable information [Ref. 20: p. 1079]. This is accomplished by scanning the document, converting it into machine code, and automatically transferring the coded matter to magnetic storage media for subsequent editing or printing.

Several fonts are commonly being used for optical character reading. Single-fonts are stylized machine printed fonts with small character sets containing numeric or alphanumeric characters plus a few special symbols. Multifonts are machine printed fonts with a large number of characters as well as hand printed numerals. Two fonts – the OCR-A (formerly ISO-A or ANSI-A) and the OCR-B (formerly ISO-B or ECMA-11) have been agreed upon as ANSI (American National Standards Institute) standard fonts.

Of the various kinds of optical character readers available, there are nine generally accepted classifications:

- General purpose page readers.
- General purpose document readers.
- Journal tape readers.
- Special purpose page readers.
- Special purpose document readers.
- Microfilm readers.
- Miniature hand held character readers (optical wands).
- Stationary slot scanners.
- Stationary industrial scanners. [Ref. 20: p. 1082]

There are four groups of typical OCR applications which are presented as follows:

- Data entry systems in which an inscription can be read repetitively at different times and at different places. Example: Circulation control in libraries where each transaction record is created by scanning the borrower's identification card and the book identification number.

- Nontranscriptive data entry systems with computer generated "turnaround documents". Example: A publc utility billing or notice of payment due which requires the return of the bill stub with the payment.

- Systems with nontranscriptive data entry "without turnaround documents". Example: The recording of incoming orders.

- Systems with conventional transcriptive data entry. Example: The need to transcribe the original document for some control purpose. [Ref. 20: pp. 1083-1085]

J. MICROGRAPHICS

Micrographics is defined as the capture, retrieval, and display of miniaturized, high resolution photographic images,

either as text or graphics. It provides quick and inexpensive duplication of documents for distribution, viewing, and recreation of hard-copies of microforms.

Micrographics provides for compact storage of files. With an array of film types, techniques, and retrieval capabilities, micrographics affords many benefits:

- Economy of document and file creation.
- Economy of duplication.
- Rapidity of duplication.
- Economy of distribution.
- Reduction of filing costs.
- Reduction of misfiling.
- Compact storage.
- File integrity.
- Speed of retrieval.
- Economy of retrieval.
- Portability.
- Protection of vital records and disaster recovery.
- Backup of on-line files. [Ref. 4: p. 126]

Basic limitations for micrographic use are that microfilm provides no space for annotation and the viewer must have a terminal.

K. PRINTERS

Printers used for either on-line or off-line computer output fall into two main classes, impact and non-impact, depending on whether there is contact between the printing

element and the paper. A printed character can be represented either by uninterrupted strokes or by dots giving the impression of an uninterrupted stroke. Hence, printers are classified as either face character (letter quality) or dot character (dot matrix). Both categories include serial (character-by-character) as well as parallel (line-at-a-time) printers.

Non-impact printers are generally faster than impact printers but have the drawback of being unable to generate carbon or carbonless copies. All impact printer designs are based on electromechanical principles. Non-impact printer designs are based on three main principles – electrostatic, thermographic, and ink-jet printing.

Face-character impact printers are classified into five categories: type-bar printing, barrel printing, chain and train, cylinder or drum printing and daisy wheel or petal printing. In parallel type-bar printing there are as many type bars (hammers) as there are print positions (columns) on a line. Instead of the normal carriage shift, the print bar shifts horizontally and characters are struck by the hammers. In serial type-bar printing just the opposite of the above occurs with the carriage moving horizontally. The familiar IBM "golf ball" shape is a combination of the two forms above.

In barrel type printing the barrel head is cylindrical and contains several rings of characters. The barrel rotates

as the cylinder passes along the axis positioning the correct character to be printed. Daisy wheel printing uses a print mechanism resembling a spoked wheel. Each spoke has a print character embossed on the tip, and the whole wheel revolves to allow the correct character to be positioned for printing. The fourth technique, drum printing, is similar to barrel printing. All the characters are engraved on a rapidly revolving, solid cylinder. When the appropriate character on the cylinder is in the correct position a hammer strikes the paper leaving the imprint. The final category, chain or train printing, employs a chain which rotates horizontally with the characters attached. As the chain passes the correct position hammers strike the characters to be printed [Ref. 20: pp. 1159-1163].

Dot-character impact printers are classified into two categories, serial and parallel, printing one character at a time or one whole horizontal line of dots at a time.

Face-character non-impact printers are limited to copying and reproducing machines rather than data output. Exceptions to this rule generally imply the use of electrostatic processing [Ref. 20: p. 1163].

Dot character non-impact printers employ the three principles cited previously. Electrostatic techniques form a latent image by making use of the electrical characteristics of the materials or writing elements being used.

Thermographic printing uses heating elements in the print head to create the character impressions on special heat-sensitive paper. The ink-jet principle makes use of electrically charged droplets of ink, whose sensitivity to the electric field towards which they are fired causes the image of the character to be printed on standard paper [Ref. 20: pp. 1163-1165].

L. SUMMARY

The tools of automation discussed throughout this chapter are the primary means by which the work in automated offices are performed, but they are far from being inclusive. Advanced discussions could include such items as copiers, terminals, graphic displays, card and tape readers, software, languages, computer-assisted instruction, CRT displays, typesetting, information packaged services, decision support system packages, or complex networking systems. Some of these technologies will become obsolete over time and others will evolve which transcend the present levels of automation. The keys to successful offices of the future will be flexibility, careful planning, and a continuing education process in how the tools of technology can help expand and improve man's horizons of productivity.

VI. THE SYSTEMS APPROACH

A. GENERAL

As seen in Chapter V, there are many alternatives available from which an organization can mold and construct an automated office. How the planners of OA systems go about determining which products are best suited for their organization will be partially discussed in this chapter and in the following chapter.

B. DISCUSSION

An integrated office automation system is composed of the equipment and technologies discussed in the last chapter and is concerned with the communications aspects covered in Chapter IV as well as the processing, storage, and output of information. Individually, the tools and technologies of OA perform only singular applications, but when integrated, they form efficient and economical means of managing information with limited amounts of human intervention.

Engineered to accommodate extended application functions as well as the complex needs of the system as a whole, integrated systems are generally custom designed and tailored to fit the needs of each individual organization. However, customizing is not always necessary and there are a number of commercial software packages available which can be purchased to meet installation requirements on new or pre-existing equipment.

Despite the availability of a relatively wide range of new technologies, no organization has yet put them all together [Ref. 15: p. 128]. The primary reason is that they don't all work together. As yet there has been no protocol standardization throughout the computer industry, consequently much of the equipment designed for use in automated offices is not only incompatible between manufacturers, but in many cases a company's own products are incompatible with each other. The situation is thus caveat emptor.

Another form of incompatibility which hinders the integration of systems design is the inconsistency in device functions. Telephones and typewriters are essentially the same, but no two word processors, copiers or computers function alike. Consequently, systems planning is extremely difficult and necessary in order to find compatible equipment that will interface harmoniously today and provide for future expansion tomorrow.

C. SYSTEM COMPONENTS

Integrated office systems are composed of three main groups: basic, optional, and extended application components. Basic components consists of office automation equipment that are found in nearly every possible configuration, e.g., word processors, printers, etc. Optional components are a bit more complex but consist of equipment still common to many automated office systems. Examples include electronic calculators, soft-copy facsimiles, store-and-forward facsimiles, and sorting

capabilities. Extended-application components are those elements that are generally limited to one operating group within a user community such as a specific department or individual. Specialized software and personalized computing are examples of extended-application components.

Each of these three main groups cited above can be further decomposed into three functional elements - action, control and inquiry. Action permits a functional element to perform some activity, for example a word processor permits text editing and a graphics module permits the creation of graphs. Control elements are responsible for the guidance of some function, e.g., electronic calendars and ticklers. Inquiry elements access preexisting information. Examples of such elements are search and retrieval, directories, and input/output control of physical files.

D. INTEGRATED SYSTEMS

Because of the wide range of opportunities available in technology and equipment there are no clear cut definitive guidelines on how to configure and integrate an automated office system. Additionally, because the field is rapidly evolving and constantly changing there is no one specific reference that systems planners can consult to obtain such information. Inquiries and research are limited to the various vendors, consultants, analyists, project planners and engineers of the computer and communications industry.

One such consultant, David Barcomb, who has been a pioneer in the field of office automation and who has served as a consultant on office automation projects for major multinational firms, describes seven basic configurations of integrated office automation systems (IOAS) in his book, Office Automation: A Survey of Tools and Technology. The discussions which follow are taken from that work and are representative configurations available to planners of office automation projects. Additionally, included in Appendices A through G are the possible systems configurations provided by Mr. Barcomb.

Each of the configurations discussed represent the primary applications of information - text, data, voice or image - and each system presents an element of economic consideration. The more complex the system becomes as a result of additional communication channels, increased information services and peripheral devices the greater the costs. Additionally, an organization unable to commit large financial resources initially to a complex system, may commence with a simple system and expand it over time, provided that the initial system was carefully planned and documented to permit such growth and future conversion.

1. A Single-Mode Terminal-Based Electronic Mail System

A single-mode computer-based messaging system (CBMS) serves multiple functions and can be applied to nearly every organization regardless of size. The software may have multidocument natural-language filing capability and automated

retrieval. Hardware consists of stationary and/or portable terminals used to access an electronic mail system. Features offered by this system include message handling, filing, retrieval, automated file searching, and open-loop computer-aided retrieval. A number of these systems are currently in use and the system software is commercially available (Appendix A).

2. A Two-Mode Word Processing/Electronic Mail System

Very much like the single-mode system, a two-mode word processing system utilizes stand-alone word processors to expand the system functions. The processors are used for off-line message preparation and material updates as well as text editing. Additionally, they may serve as terminals for an electronic mail system or for data processing applications on a timesharing basis. Used in conjunction with the electronic mail system, the processors can provide "roll ups" which are the assembling and editing of information from several sources to provide summarized reports for presentation to higher levels of management. The summarized reports may be disseminated electronically via the electronic mail system to mail system users and in hard copy to others. The software is commercially available (Appendix B).

3. A Three-Mode Integrated Mini/Mainframe System

This system has the capability of joining two otherwise incompatible computers, e.g., a minicomputer from one vendor with a mainframe from another. Typically, the front-end

minicomputer services all communications, contains the software for the integrated system and performs all computing related to the integrated system. The mainframe serves as a file processor as well as performing conventional data processing uses. The system has a graphics feature which can transmit graphics between nodes via the electronic mail system on a store-and-forward basis, just like text and data. The basic software is available commercially; however, the software interconnecting the mini with the mainframe is proprietary (Appendix C).

4. A Three-Mode Integrated System

This system provides text, graphics, and audio capabilities. Text editing is done by a stand-alone communicating word processor that is capable of preparing off-line electronic mail and provides magnetic capture and storage. Graphics in this system are produced through the use of freestanding facsimile units that communicate among themselves.

The third mode provides audio teleconferencing, with both text and graphics support. The electronic mail system transmits any material needed for an audioconference and the facsimile units transmit any necessary graphics. The electronic mail system is the only component commercially available (Appendix D).

5. A Four-Mode Nonintegrated System

In this system, clerical workers and word processor operators handle all input and output (there are no individual

terminals for principals (management)). Optical Character Recognition page readers permit typewriters to function as input devices and the text is scanned onto the magnetic media of the word processors. Finally, there is no terminal-oriented CBMS. The electronic mail is forwarded point-to-point via communicating word processors, and principals receive incoming mail via hard copies generated by word processing equipment (Appendix E).

6. <u>A Four-Mode System with Shared-Logic Word Processors</u>

This variation uses word processors to serve principals who do their own keying (keying barely exceeds that required to operate a pushbutton telephone). Principals can review drafts, messages, documents, scan files and can dictate editorial changes. Terminals have access to on-line word processing files and provide dial-up access to both the electronic mail system and word processing systems for direct transmission and receipt of documents. Optional software features include math, sorting, and records management utilities. The word processing and electronic mail software systems are commercially available (Appendix F).

7. <u>A Four-Mode System with Timesharing Graphics</u>

The most sophisticated and complex of the seven examples discussed, this system includes a terminal-oriented CBMS with interconnection to TWX and Telex (teletypewriter systems) through a manually-operated paper tape switching center, electronic filing and retrieval, automated parametric file

searching, tickler files, word management/document subsystem, electronic calendaring with automated appointment scheduling, a user directory/personnel locater subsystem and interactive timeshared graphics. The facsimile and teleconferencing features are electronically discrete. Computer output micro-film is used to purge text files in the word processors and throughout the integrated system. A similar system to this, uses voice-output electronic mail to convert the headers and text of messages to audible form. By use of tone-operated telephones, users may dial in from remote locations and hear their electronic mail read to them. Software for this system and voice-output electronic mail remain proprietary (Appendix G).

VII. IMPLEMENTATION

A. GENERAL

Previous chapters have laid the foundation for the needs and purposes of office automation in a progressively technological society, and have looked at the tools and technologies available to fill those needs through the use of integrated communications and office equipment packages. Given the advanced technological skills and the resources (i.e., time and money) necessary to institute an integrated office automation system, there still remain several factors which significantly influence an organization's ability to make such a transition.

Foremost among these considerations is the implementation procedure itself. Sometime in the last 20 years, most of the major organizations in the United States have undergone the trials and tribulations of implementing data processing installations. In many respects, the implementation procedures for office automated systems are the same as for data processing, in that they too require feasibility studies, systems planning, systems requirement statements, organizational adjustments and postimplementation procedures. They differ, however, in the impact that they have upon the infrastructure of the

organization, the socio-technological influences of implementation.[1]

This chapter looks at those socio-technoligical problems with special emphasis on the social implications that are brought about through the implementation of office automation. It compares the types of implementation strategies available and is concerned with a few of the technological obstacles affecting productivity. Finally, it presents a guideline for planning and implementing OA systems in small and large, more complex organizational structures.

B. SOCIAL IMPLICATIONS

The use of computers and communications technology to support office functions provides the potential to alter the locational and temporal definitions of large numbers of office jobs. In Chapter II it was stated that the physical boundaries of offices were no longer apparent and that many of the functions routinely performed within the confines of the office could now be accomplished in remote locations. The alternatives

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[1] This aspect of OA can be tied into various theories and models of the social dynamics of computing development and use in complex organizations. The web model presented by Rob Kling and Walt Scacchi [Ref. 42] emphasizes the impacts implied here including the social and political context in which the computer-based system is embedded as well as the infrastructures (skilled staff, operations procedures) for supporting systems development. The WEB theory is particularly appropriate in the study of OA because of the manner in which it interfaces with the complex social issues inherent with the implementation of automated office systems.

to the traditional work arrangements mentioned above provide for a new form of flexibility in location and definition of work which differ in scope and structure from the past. Among the alternatives are the following forms of remote work options [Ref. 43:183]:

- Satellite work centers
- Neighborhood work centers
- Flexible work arrangements
- Work-at-home opportunities

A satellite work center implies that an organizational division such as accounting or data processing be located within convenient commuting distances of the greatest number of employees in a geographical location. The logic is to provide shorter commuting distances and a "critical mass" of employees which will provide the necessary social interaction as well as a sufficient hierarchical structure to provide adequate on-site management. The social implications of this arrangement are that while it reduces commuting time and expenses, it also raises problems of remote supervision and social isolation from professional peers. It also implies a radical departure from past managerial techniques as well as strong commitment in terms of money and resources.

Neighborhood work centers provide employees from different organizations the opportunity to share space and equipment in a work center close to their homes. Economies of scale are achieved through equipment and services such as facsimile

transmission, hardcopy printing, teleconferencing facilities, etc. Under this arrangement of work, remote supervision is assumed to be affective and the worker somewhat autonomous. Equipment and facilities costs are shared by participating organizations.

Flexible work arrangements provide alternatives particular to the professional and managerial employee. Companies utilizing this arrangement frequently encourage their people to stay at home and complete critical work assignments to avoid office distractions, or permit their employees to set up their own work schedules. When working in remote locations, communications with the main office are completed via computer terminals (electronic mail) provided by the company.

The fourth form of remote work is similar to flexible work arrangements but it differs in that it allows the employee to remain home several days a week or on a full-time basis. Theoretically it provides a great deal of individual freedom, but it is heavily dependent on remote supervision and provides even less interaction than a satellite or neighborhood work center. This arrangement provides employment opportunities for the elderly, handicapped, and child-bound parents. Disadvantages are isolation and a tendency to become too autonomous and separated from corporate objectives and influences.

There are several social implications which can be derived from the above four examples. Of concern is the long term career potential of an individual in an environment where

visibility has always been crucial to promotion. With the office limits now extended, will the employee suffer from the old adage "out of sight, out of mind" or will some other form of visible measurement be instituted such as management by objectives which will enable him to stay competive with his peers?

Another long term consideration is corporate image. For those organizations which are basically monopolistic in nature such as public utilities, what will be the impact of customers who see their neighbors staying at home and drawing full salaries?

Other considerations include salary and fringe benefits. Will those who work in remote locations receive salaries or will piece rates be established based on numbers or quantities of work completed? How will employee insurance protection cover the individual who works at home? How will such arrangements affect union contracts?

Another social implication is who is best suited to work in a remote environment? A single person who lives alone might appear an ideal candidate for such an assignment. On the other hand, that person might be the one who most needs the social activities and contacts of an office environment. Other findings substantiate that in many cases those who worked at home had difficulties with their families accepting that they were not available to take care of family needs during this time.

To many people, the office is a link to society and if the traditional environment is going to change, then some form of institution must replace that link. For others, the office offers a source of community, team spirit and participation. It is a commitment which regulates their lives. If remote work centers offer too much flexibility, then the imposed routine of the office and going to work will have to be replaced by self-imposed discipline, a factor which may be a weak link in the personalities of many employees. Additionally, working at home provides no incentive, no reward, no sense of personal accomplishment for making the extra effort. Consequently, there is no sense of closure or completeness when the day is done. There will be no escape from home and office [Ref. 44: pp. 44-45].

Presently there are no clear cut solutions for those who work on the periphery of automated offices. While man has provided the technological tools to expand his capability for work, he has yet to overcome all of the psychological and sociological influences that have traditionally bound him to his environment. Just as important to the continued advancement and implementation of complex integrated office systems in the future will be the challenge to find feasible alternatives which meet the changing needs of, not only organizations, but the individuals who function within those organizations.

C. SOCIO-TECHNOLOGICAL IMPACTS

The preceding section acknowledged that shifting trends in office work as a result of changing technologies may lead to serious social implications in the future. While this premise was based primarily on the transition to remote work locations, it cannot be ignored that employee attitudes, management processes, interpersonal relations, interdepartmental relations, and organizational structures will also be altered by automated office systems through shifts in the mode and timing of communications, and changes in the work product itself. these shifts will result internally (meaning within the central office environment) as well as externally (remote locations) as time and technology change [Ref: 45].

Much research remains to be done on how office automation affects all facets of an organization. As discussed in Chapters II and III, it is relatively easy to measure the quantitative benefits derived from OA implementation, such as manual filing systems versus automatic filing and retrieval, use of electronic mail versus standard memos and letters, and the cost savings of teleconferencing over travel expenses. The intangible aspects of OA however present far different criteria for measurement: unfortunately, research in this area has provided little guidance to date.

Olson and Lucas [Ref: 45] have identified 18 research propositions which they refer to as the "socio-technical" aspects of organizations, that is, the social and technical-economic elements of an organization which interact to

produce some predicted outcome. The underlying objective of their work is that the behavioral and organizational implications of OA systems are not well understood and that if productivity and effectiveness are going to improve, a better understanding of these critical factors must be reached. Broken down into seven major groups, they impact on the following areas.

- Effects of Office Automation on the Nature of Work
- Effects of Office Automation on Individuals
- Effects of Office Automation on Organizational Communications
- Effects of Office Automation on Management Processes
- Effects of Office Automation on Interpersonal Relations
- Effects on Office Automation in Interdepartmental Relations
- Effects of Office Automation on Organizations Structure and Processes

The propositions outlined above provide a basis for research into the behavioral and organizational impacts of OA. The propositions for the most part have not been tested, and are meant only to imply the potentially widespread impact of OA. Their overall implication suggests that unlike many technological developments which improve organizational efficiency, OA systems have the potential to bring about profound and cataclysmic changes in the nature of organizations.

D. OBSTACLES TO IMPLEMENTATION

The driving forces of office automation are profit, increased productivity, growth in business scope and in the need for

management control, changing role of women, government regulation, the accelerated pace of business, a need for more responsive and meaningful information, and a continued emphasis for job enrichment and fulfillment [Ref. 46]. Achieving and developing a program that will accomplish all of these desires is difficult. There are major obstacles which must be overcome and suitable means for circumventing these must be discovered. They are:

- Few proven methodologoies to emulate
- Finding a suitable implementation strategy
- User resistance to change
- High costs of getting started
- Difficulty in measuring productivity gains
- Lack of top management support

A major obstacle [Ref. 6] is the lack of proven methodologies in office automation to emulate. Growth has been so rapid that analysts have had little opportunity to evaluate and research the technical and sociological problems mentioned in the previous section. Consequently, there has been a reluctance for some organizations to "pioneer" the way without models to emulate, while others have created ad hoc growths. Very few have established completely integrated systems, but more and more are now under development and the future should be much brighter as proven systems become available to model.

Another problem is finding a suitable implementation strategy. Because of the rapid growth in the OA field, many

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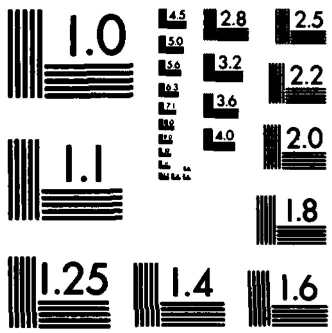
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alternatives have become available making it extremely difficult for planners, designers, and management to select a single approach. Without identifying product types, there are five major forms of implementation strategies [Ref. 4: pp. 23-24].

1. Horizontal - one functional tool at a time until that tool has been put into production across the organization.

2. Vertical - implements the full range of tools in one department or group at a time.

3. Matrix - introduces 1 or 2 tools horizontally throughout an organization, then expands them vertically in selected departments on an as-needed basis.

4. Shotgun - implements random tools in random departments with little or no overall coordination.

5. Chorus line - involves implementation of selected tools in selected departments on an as-needed basis, but in this case they have all been approved as part of a master plan to ensure ultimate compatibility and integration - placing tools first where they will do the most good.

User resistance to change is a third obstacle which must be surpassed to realize productivity improvements. Automation has been viewed as a threat to many employees who fear they will be replaced by machinery. That perception is gradually dissipating as workers begin to realize that OA is providing not a threat but a means by which they can enhance their jobs and improve their productivity. It is introducing a new self-esteem which hopefully will turn the corner on old misconceptions.

The fourth major hurdle is high start up costs. As mentioned in previous chapters, the cost of automation is high and

significant capital outlays are required even for pilot programs. Equipment cost, software, installation and maintenance, training, documentation, and support personnel all fall under this umbrella. There is no way to avoid high initial costs for OA, but once committed the costs will begin to be recouped immediately.

Difficulty in measuring and reinvesting productivity gains has already been discussed in great depth throughout this work. There are no clearcut measurements. Because of the nature of how knowledge workers spend their time, the efficiency benefits of OA are spread over activities in small percentiles, e.g., 4% reduction in personal processing, 4% reduction in information retrieval, etc. Organizations shifting to OA seeking quantitative benefits as opposed to qualitative or value added benefits will find this obstacle extremely difficult to overcome.

The last major obstacle pertains to management's support or lack thereof. Without strong commitment from senior executives, it is highly unlikely that productivity benefits can be achieved or sustained. Top level management must be firmly convinced of the productivity potential of OA, and funds and resources should be committed over a 3-5 year period to realize that potential. Anything less than a strong, consistent endorsement by management will discourage and promote failure of OA implementation.

Not included above but certainly an obstacle to any OA program is the fact that even after implementation not all of the expected benefits materialize [Ref. 47]. Among these are:

- Automation procedures may make some tasks boring, fatiguing and ultimately error prone.
- Individuals may fail to use their new free time to organizational advantage.
- Professionals may actually do more clerical work instead of applying their time creatively.
- Controlled performances may also add more stress rather than relieving it.
- Electronic mail may actually proliferate communication channels and undermine organizational effectiveness.
- Changes in traditional work relationships may create pockets or isolationism, supervisor problems, and disorientation in employee-employer roles and behaviors.
- Changes in traditional work relationships and locations may cause major changes in management stypes and techniques as well as organizational structures.

These obstacles point out that the road to office automation is not an easy one with clearly defined milestones and objectives. The implementation procedures and obstacles herein present different problems for each organization which management must contend with during all phases of the implementation project and throughout its expected life cycle. Correctly and wisely installed, office automation can bring countless benefits to organizational productivity; incorrectly managed it can become an expensive albatross for many years to come.

E. IMPLEMENTATION PROCESS

The implementation processes for office automation follow the same systems development processes associated with creating any new information system. Consequently, little pioneering is required which is outside the normal management procedures, and a variety of sources provide step-by-step explanatory details for systems development [Refs. 19, 48, 49, 50, 51]. What is required is creativity to implement a system that is subject to a wide range of influences; business markets will change, new products will appear and others vanish, executive changes will signal new organizational directions. Changing needs will require changes in office automation systems and a flexible system will have to be continually updated [Ref. 4: p. 225].

While it is recognized by most leaders in the field of OA that well thought-out, strategically planned, top-down implementation procedures are the only economical and efficient method for implementing an OA system, there are others who strongly advocate the bottom-up approach, supported by pilot programs to "sell" upper level management on the benefits to be gained [Ref. 51, 52]. This thesis advocates the first alternative based on the belief that business economics dictate structured design and budgetary planning. Otherwise there is little hope of gaining upper level management acceptance. High capitalization of equipment as well as high costs of money also support this approach, combined with the belief

that if management does not fully support the project from the beginning then there is little chance of a successful implementation.

The system development process cited in the above references supports four major phases, each containing several steps. Each step is a logical part in accomplishing the objectives of that particular phase.

1. <u>Phase I - Systems Planning</u>

Implementation of an OA system begins with a planning phase to formalize and determine the need for the system. Within this phase the first step is to conduct an initial investigation to determine whether a feasibility study is warranted. If management (or a steering committee appointed by management) perceives that a feasibility study is worthwhile, a committee is generally appointed to proceed. Step 2, which is the feasibility study, is a report to management of the probable characteristics, costs, and benefits of implementing the system as well as a formal report of the generalized project requirements. Reports are based on information gathered from users, systems analysts, and consultants. The end result of a feasibility study is a decision by the steering committee to either cancel the project or to proceed on with the next phase.

2. <u>Phase II - Systems Requirements</u>

The second phase of the OA system development process provides the detailed foundations upon which the technical

programs and procedures will be developed. Emphasis is directed toward analysis of user operations, e.g., clerical worker, professional, or upper-level management considerations. Once user requirements are understood, then the technical aspects of the system can be determined. These include communications channels, equipment integration, and installation sites. This phase ends with another review by the steering committee and a decision to either terminate or proceed with development.

3. Phase III - Systems Development

This is generally the largest and most complex aspect of the implementation process. It commences with an accepted conceptual design approach and an agreement to purchase hardware, software, and applications packages for at least a pilot program. It terminates with a developed system that has been thoroughly tested and prepared for implementation. Included in this phase are the following:

- Steps to support detailed design specifications
- Implementation of the technical support functions
- Application specifications and programs
- Preparation procedures
- Training users
- Planning for conversion and full implementation
- Testing of the system

Pilot projects or prototypes are installed and user groups are afforded the opportunity to use, familiarize, and evaluate the system for usefulness and productivity.

The third phase ends with another presentation to the steering committee summarizing the results of the development and testing efforts and an agreement by all parties (users and various departments, plants, factories, offices, etc.) that the new system should be implemented. The steering committee makes a final decision to terminate the project at this time or to direct full scale implementation of the system.

4. Phase IV - Systems Implementation

The final phase is the actual implementation of the system as designed. During this phase files are converted or microfilmed, final training is conducted, new programs and procedures are initiated and old processes are discontinued. Refinements and tuning operations are performed to correct deficiencies and to enhance effectiveness. Finally, after sufficient operational time and corrections, a post-implementation study is completed to compare actual results to original concepts and plans.

Appendix H contains an outline of the implementation procedures outlined above plus an estimated percentage of total systems effort that is applied to each phase and step of development.

The implementation procedures discussed above are only a guideline and in no way imply that such a methodology is fixed in concrete. On the contrary, there are probably as many ways to implement an automated office system as there are ways to configure such a system. For example, Dr. Lynn Hazlett,

vice president of MIS for Levi Strauss, suggests the establishment of an Information Resources Department responsible for development and operation of the organization's OA system. This would entail an Information Processing Manager, a Communications Manager, an MIS Manager, and an Advanced Planning Manager all reporting to a vice-president of the department [Ref. 46: p. 72]. No system or implementation strategy is wrong if it can be managed and made to work in an efficient and economical manner. Furthermore, no system is ever complete since changing needs will require constant update and revision throughout the life of the system.

F. APPLICATION TO GOVERNMENT

There is no question that office automated systems have applicability to the government and specifically the military. No other single agency or organization employs as many people or generates as much paperwork as the federal government. One would therefore presume from the studies and material provided throughout this thesis that the government would be the number one leader in office automation technology. Unfortunately, it is not.

Several reasons exist for lagging implementation in the government sector. One cause is restrictive government regulations which strangle and discourage users from the advanced technologies and benefits that can be obtained from the placement of new systems. By the time bureaucratic requirements and procedures are satisfied, "new" technologies have been

superseded. Comparison of government procurement of data processing equipment versus civilian procurement substantiates that it takes nearly five times as long to obtain and install government installations.

Additionally, because of current methodologies of procurement there are no guarantees of compatability either in present generation equipment or in follow-on generations. This has a tendency to drive up conversion costs as old equipment is replaced by new.

Dollar thresholds and unrealistic time frames exacerbate the serious flaw of incompatibility. When dollar limitations cloud issues and increase procurement time, smaller, less expensive systems which circumvent the procruement process are purchased to provide immediate needs and fulfill existing requirements. This leads to multiple systems within the government which have no compatibility with one another. Martin describes this as follows:

> "the major danger of separate data systems arises when the data are designed in incompatible ways. As we have discussed, many corporations, government departments, and military organizations have a staggering need to merge data or develop applications which use data from separate systems. It becomes a Herculean task to clean up the mess, and in most cases the desireable conversion or migration is never performed." [Ref. 9: pp. 250-251]

Widespread proliferation of office systems currently exists. this is not surprising when reviewing the pyramid in Chapter II which shows that basic OA systems start with the use of electric memory typewriters and advance from there. What is surprising is the lack of organizational development and

guidance that exists in government to channel and create compatible and cohesive systems capable of interacting with one another. No central steering committees exist within the government or the military to perform the necessary planning functions for long range interfacing and implementation. The results are pockets of ad hoc groups each pursuing their own specially designed programs, installing systems or pieces of systems here and there, with no little hope or chance of ever bringing them together.

This seemingly negative outlook does not imply that achieving any procress in the government environment is not possible. On the contrary, there have been cases within the federal sector which indicate that office automation can be and is being successfully used. Within the U.S. Department of Transportation, TAOS (Transportation Automated Office System) a menu-driven system serving 160 terminals, provides the following features [Ref. 54]:

- Complete calendaring system
- Personal and public directories
- Electronic mail
- Electronic tickler files
- Desk calculation
- Word processing
- Management controls consisting of:
    * correspondence management
    * project tracking
    * suspense file processing

- Interfaces to external databases

- Remote functioning

- Braille terminals for the blind

Project IMPACT (Improved Administrative Capability Test) which was an Air Force office automation project conducted at Hanscom Air Force Base, Bedford, Massachusetts under the supervision of Booz, Allen, and Hamilton, Inc., produced the following findings about OA in the military:

- An 80% time savings could be obtained by clerical workers

- A 162% time savings could be realized by professional workers

- These savings represent approximately $60 million over a five year period

Many other isolated applications of OA technology are also currently being used throughout the military. Facsimiles are frequently used to transmit necessary documentation between commands. Both the Navy and Marine Corps use microfiche via facsimile for their personnel records systems [Ref. 36: p. 62]. Electronic mail systems within isolated command headquarters are not uncommon and word processors are rapidly replacing typewriters wherever feasible.

Additionally, ARPANET (Advanced Research Projects Agency of the U.S. Department of Defense) has been around since the mid 1960's and provides resource sharing via interlocking computer systems in many different universities and research organizations throughout the country.

The question therefore is not whether office automation is applicable (since it is obviously being used to various degrees), but how it can best be employed to serve the military and government communities as a whole. With advanced technological achievements portability is almost no longer a question for the military. Applications which once required large mainframes can now fit into microcomputers the size of small suitcases. Communications technology can tie in communications links from almost any place in the world no matter how remote or isolated, and secure communications lines can be obtained through any number of encryption devices. Vulnerability to changing climates still presents some problems, but for the most part, this too has been overcome via technological achievements. Office automation is therefore accessible to all sectors of the government whether located in Washington, D.C. or aboard a ship in the Indian Ocean. There are virtually no limitations if carefully planned and implemented.

VIII. SUMMARY

Integrated office automation systems present users, information managers, and top level decision makers with a great deal of flexibility and diversity of choices for office productivity and design in the future. The field of office automation will undoubtedly change over time as planners and developers create newer and better systems. Unfortunately, businesses supporting the shifting labor trends towards white-collar employment cannot wait for the promises of tomorrow. They cannot afford to hold out for futuristic ideals, since their decisions must be based on today's technology.

The tools presented throughout this thesis provide management with an array of possibilities for decision making in today's world. The first three chapters discussed the growing concerns surrounding traditional office environments and how implementing automated office systems can not only increase productivity, but how it can provide significant financial rewards as well. Special emphasis was placed on the three P's - people, paper and products - and how OA affects these three areas within the office.

The next three chapters presented the heart of this work, the tools and technologies of office automation. Chapter IV provided the fundamental communications capabilities by which the integration of OA systems are made possible. The various

types of equipment comprising an automated office system were presented in Chapter V, and Chapter VI provided several examples of how to integrate the various tools and technologies to construct cohesive automation systems. Special consideration was directed to the fact that costs bear a direct relationship to system configuration as the degree of complexity increases from simple to fully integrated decision support systems.

Chapter VII outlined the implementation procedures for integrating an office automation system into the organizational environment and described many of the social implications associated with personnel during and after implementation. Additionally, it provided insight into the applications of OA within the various governmental sectors, including federal agencies and military organizations.

The office of the future will always be just that - "in the future" - just beyond the horizon and always just beyond man's grasp. The age of office automation, on the other hand, is here today. The technology and the tools are available now for building the advance office systems and for integrating the communications networks that are necessary for the offices of tomorrow. They are not a dream - they are not magic. They are man's invention designed and created by man to enhance his abilities and to achieve what has never been achieved before. It is machinery helping man to fulfill his greatest potential.

APPENDIX A

A SINGLE-MODE TERMINAL-BASED ELECTRONIC MAIL SYSTEM

- Software
  - Electronic mail timesharing service/software
- Features
  - Text
    - Computer-based electronic mail (CBMS)
    - Portable electronic mail
    - On-line document preparation
    - Multiauthor document preparation
    - Electronic document distribution
    - Categorized multidocument natural-language filing
    - Automated file searching
    - Tickler function
    - Telephone message filing
    - On-line user directories
    - Computer teleconferencing
    - Computer-aided retrieval
  - Data
    - Access to coresident data processing tasks and files in CBMS system
    - Access to outside data bases and DP services
  - Text/Graphic
    - Not applicable
  - Graphic
    - Video projection of terminal screen images
    - Open-loop computer-aided retrieval (off-line micrographics)
  - Audio
    - Not applicable

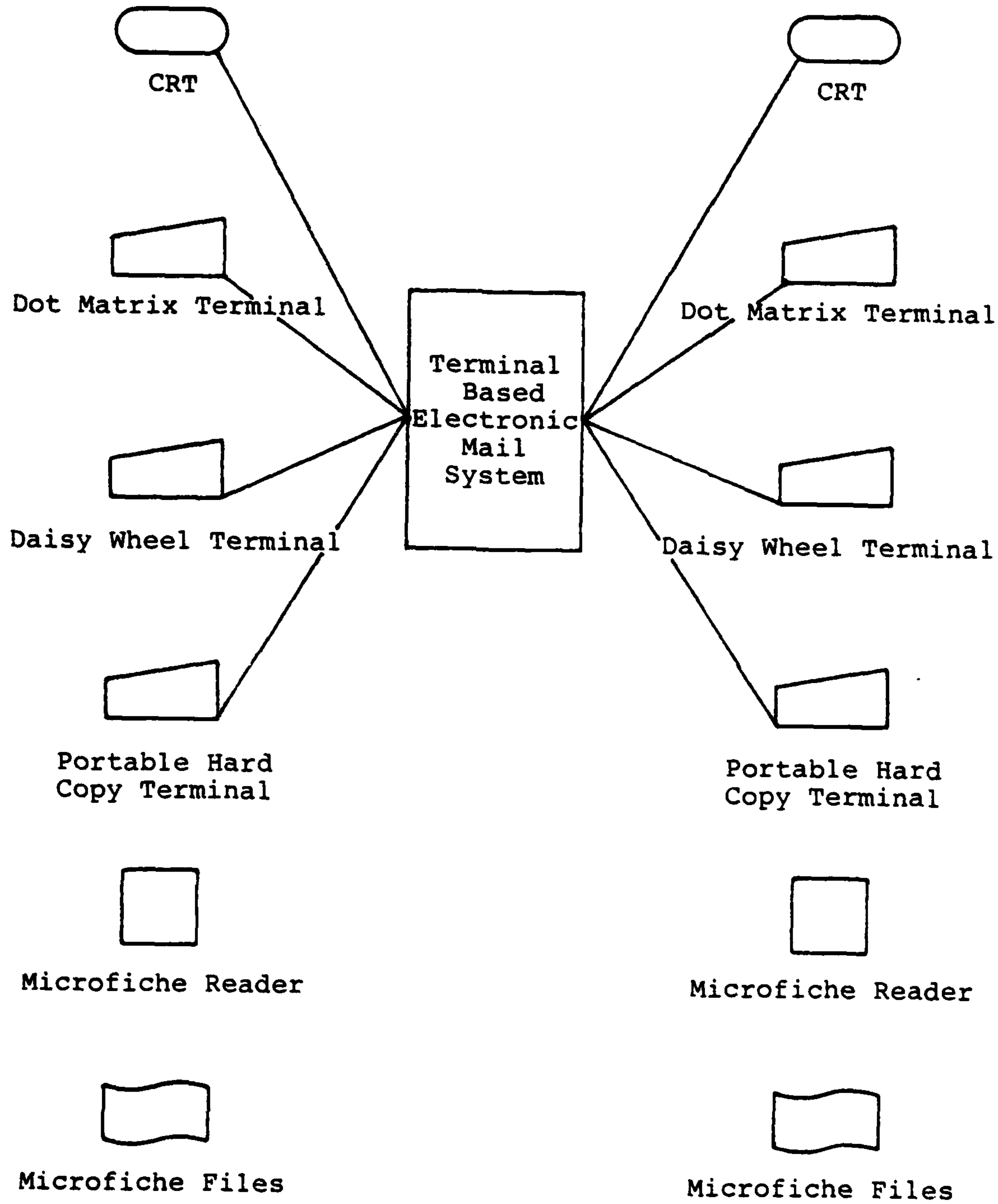

Figure A-1. Single-Mode Terminal-Based Electronic Mail System

APPENDIX B

A TWO-MODE WORD PROCESSING/ELECTRONIC MAIL SYSTEM

Software
- Electronic mail timesharing service/software
- WP software with asychronous ASCII communications

Features
- Text
  - Standalone communicating word processing
  - Point-to-point electronic mail (communicating WP systems)
  - Terminal-based electronic mail (CBMS)
  - Portable electronic mail
  - On-line document preparation (CBMS)
  - Off-line document preparation (word processor)
  - Multiauthor document preparation (CBMS)
  - Electronic document distribution
  - Categorized multidocument natural-language filing
  - Automated file searching
  - Tickler function
  - Telephone message file
  - Electronic publishing
  - On-line user directories
  - Sort utility (in WP software)
  - Math utility (in WP software)
  - Computer teleconferencing
  - Computer-aided retrieval
- Data
  - Access to coresident DP tasks and files in CBMS system
  - Dial-up access to other computers
- Text/Graphic
  - Not applicable
- Graphic
  - Video projection of terminal screen images
  - Open-loop computer-aided retrieval
- Audio
  - Not applicable

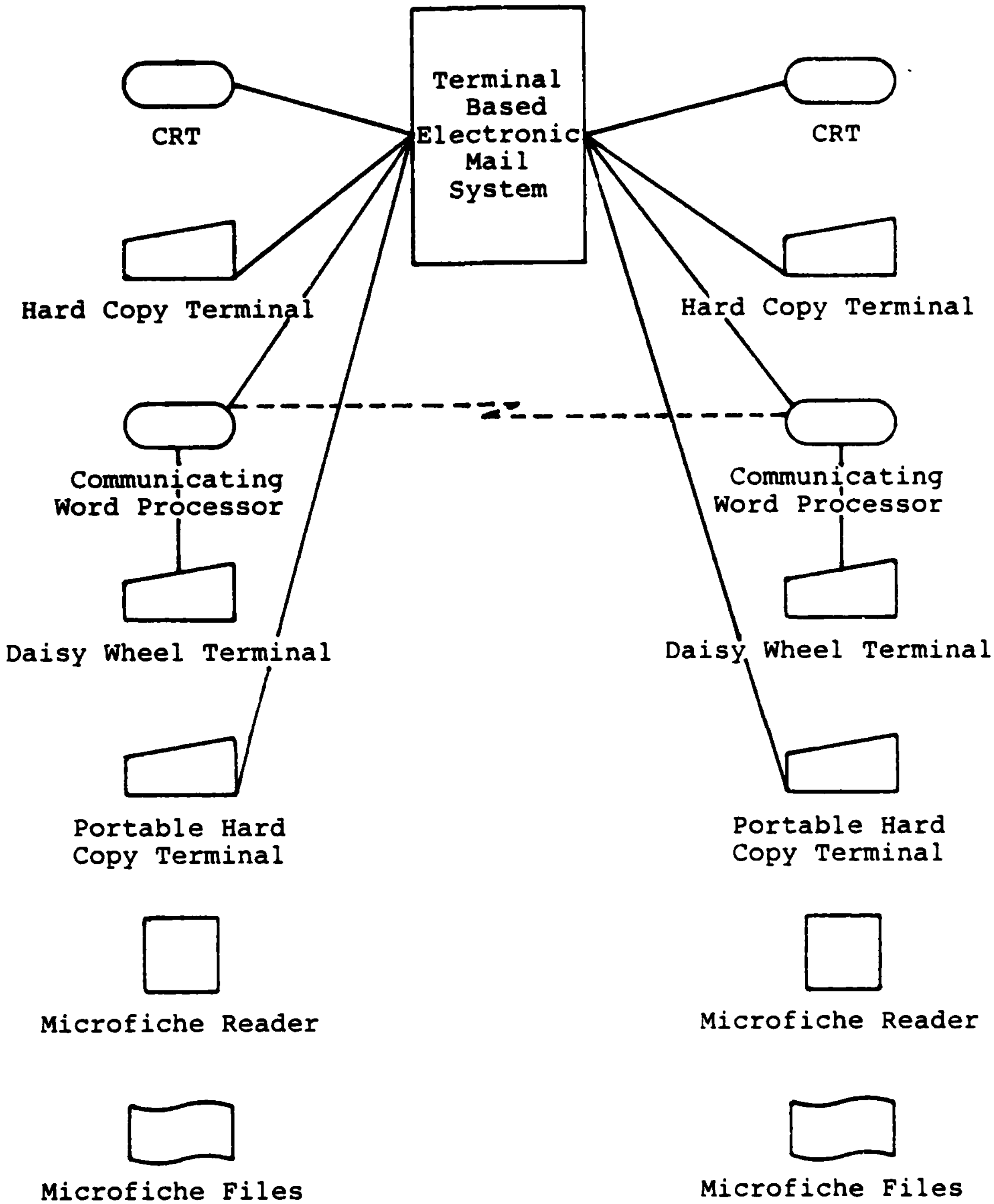

Figure B-1. Two-Mode Word Processing/Electronic Mail System

APPENDIX C

A THREE-MODE INTEGRATED MINI/MAINFRAME SYSTEM

- Software
  - Integrated office automation system timesharing service or software
- Features
  - Text
    - Terminal-based electronic mail system (CBMS)
    - Portable electronic mail
    - On-line document preparation
    - Split-screen displays
    - Multiauthor document preparation (CBMS)
    - Electronic document distribution
    - Categorized multidocument natural-language filing
    - Back-end filing in mainframe computer
    - Automated file searching
    - Telephone message file
    - Sort utility (in WP system)
    - Math utility (in WP system)
  - Data
    - Full DP capability within same computer
    - Sort utility (IOAS and DP)
    - Math utility (IOAS and DP)
    - Electronic calculator (in integrated system)
  - Text/Graphic
    - Commingled text/graphic creation and transmission
  - Graphic
    - Computer output microfilm (COM) previewing on display terminals
    - Timesharing graphics
  - Audio
    - Not applicable

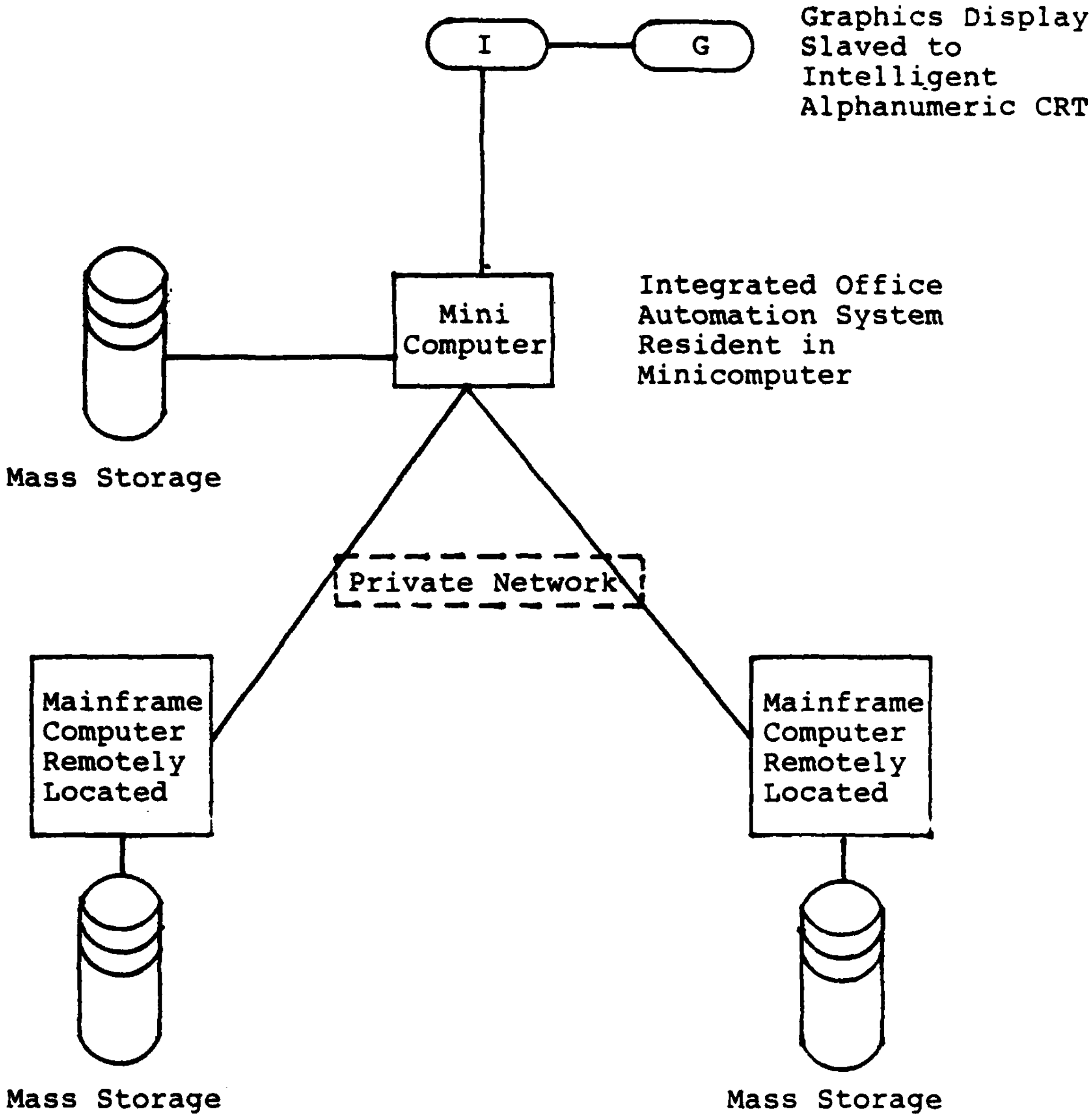

Figure C-1. Three-Mode Integrated Mini/Mainframe System

APPENDIX D

A THREE-MODE INTEGRATED SYSTEM

Software
- Electronic mail timesharing service/software

Features
- Text
  - Standalone communicating word processing (WP)
  - Point-to-point electronic mail (communicating WP systems)
  - Computer-based electronic mail (CBMS)
  - Portable electronic mail (optional)
  - On-line document preparation (CBMS)
  - On-line document preparation (word processor)
  - Multiauthor document preparation (CBMS)
  - Electronic document distribution
  - Categorized multidocument natural-language filing
  - Automated file searching
  - Tickler function
  - Telephone message file
  - On-line user directories
  - Sort utility (in WP system)
  - Math utility (in WP system)
  - Computer teleconferencing
  - Off-line phototypesetting (optional via WP system)
  - COM output (optional from WP diskettes)
  - Computer-aided retrieval
- Data
  - Access to coresident data processing tasks and files in CBMS
  - Access to outside data bases and DP services
  - Sort utility (in WP and DP systems)
  - Math utility (in WP and DP systems)
- Text/Graphic
  - Graphic electronic mail - facsimile
  - Store-and-forward facsimile (via timesharing service)
  - Portable facsimile (optional)
- Graphic
  - Video projection of terminal screen images
  - Open-loop computer-aided retrieval (off-line micrographics)
- Audio
  - Audio teleconferencing

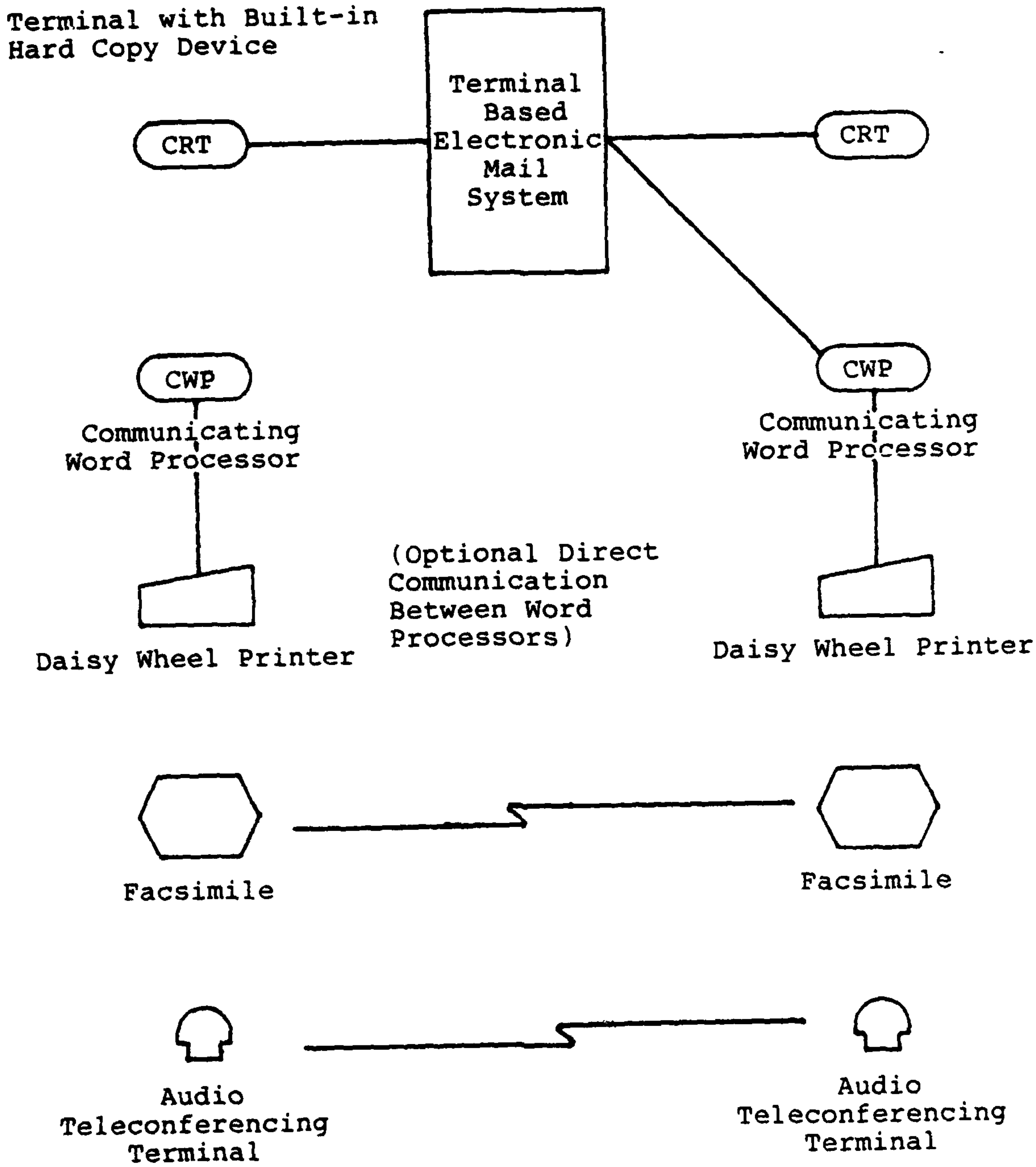

Figure D-1. Three-Mode Integrated System

APPENDIX E

A FOUR-MODE NONINTEGRATED SYSTEM

- Software
  - Word processing with communications
- Features
  - Text
    - Standalone communicating word processing (WP)
    - Optical character recognition input to word processor
    - Point-to-point electronic mail (communicating WP systems)
    - Electronic document distribution
    - Tickler function
    - Sort utility (in WP system)
    - Math utility (in WP system)
    - Off-line phototypesetting (optional)
    - COM output (option)
  - Data
    - Dial-access to timesharing computers
    - Sort utility (WP used as dial-up terminal)
    - Math utility (WP used as dial-up terminal)
  - Text/Graphic
    - Graphic electronic mail - facsimile
    - Portable facsimile (optional)
  - Graphic
    - Facsimile
  - Audio
    - Audio teleconferencing
    - Dictation - local
    - Dictation - dial-up (optional)
    - Dictation - remote control (optional)

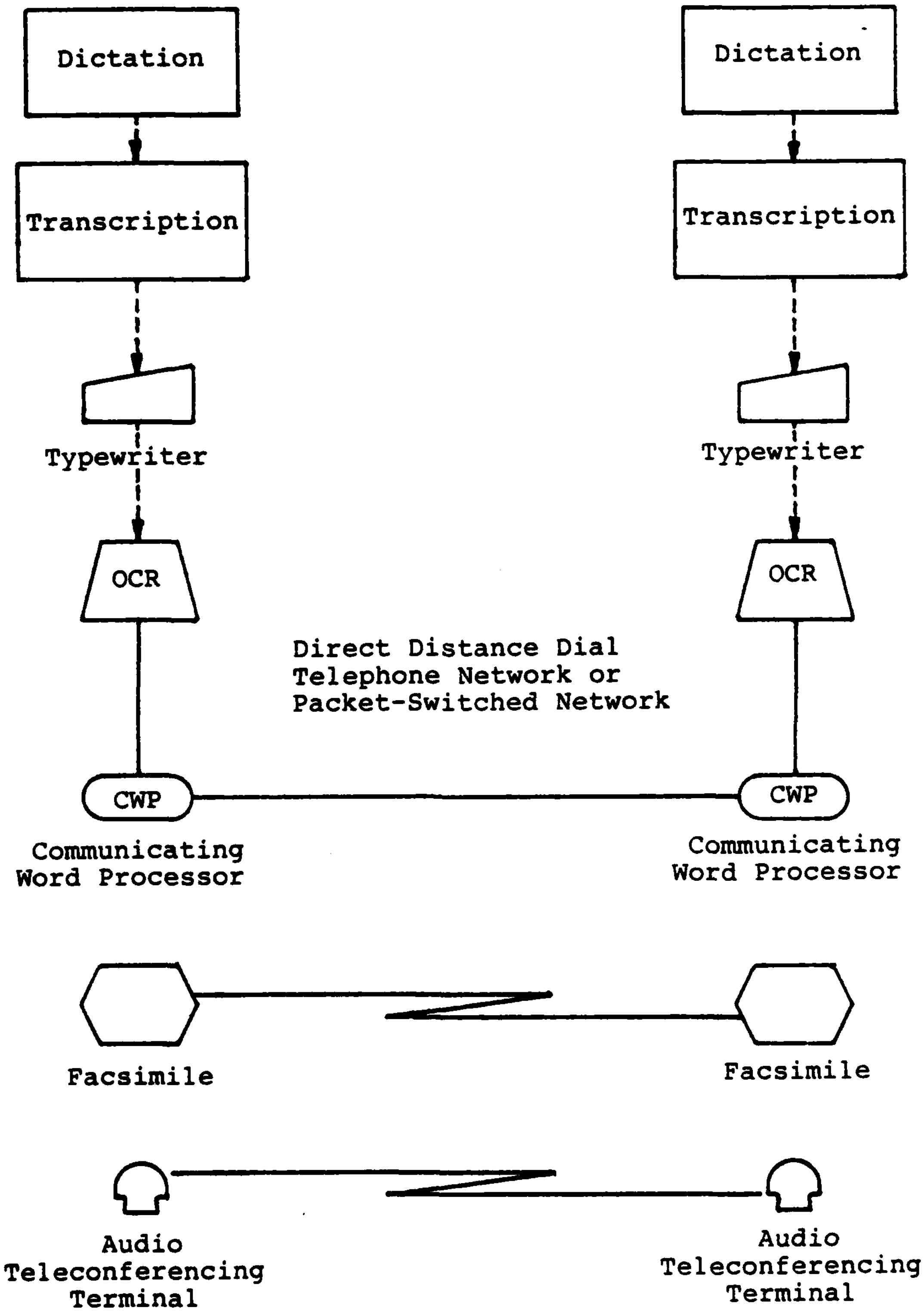

Figure E-1. Four-Mode Nonintegrated System

APPENDIX F

A FOUR-MODE SYSTEM WITH SHARED-LOGIC WORD PROCESSORS

Software
- Word processing software with communications
- Electronic mail timesharing service/software

Features
- Text
  - Shared-logic word processing
  - Point-to-point electronic mail (communicating WP systems)
  - Computer-based electronic mail (CBMS)
  - Portable electronic mail
  - On-line document preparation (CBMS terminal)
  - Off-line document preparation (word processor)
  - Multiauthor document preparation (CBMS or WP systems)
  - Electronic document distribution
  - Categorized multidocument natural-language filing
  - Tickler function
  - Telephone message file
  - Electronic publishing
  - On-line user directories
  - Sort utility (in WP system)
  - Math utility (in WP system)
  - Computer teleconferencing (pseudo version using CBMS)
  - Open-loop computer-aided retrieval (optional)
- Data
  - Access to timesharing computer
  - Sort utility (in WP system or via timesharing)
  - Math utility (in WP system or via timesharing)
- Text/Graphic
  - Graphic electronic mail - facsimile
  - Portable facsimile (optional)
- Graphic
  - Open-loop computer-aided retrieval (off-line micrographics)
- Audio
  - Audio teleconferencing

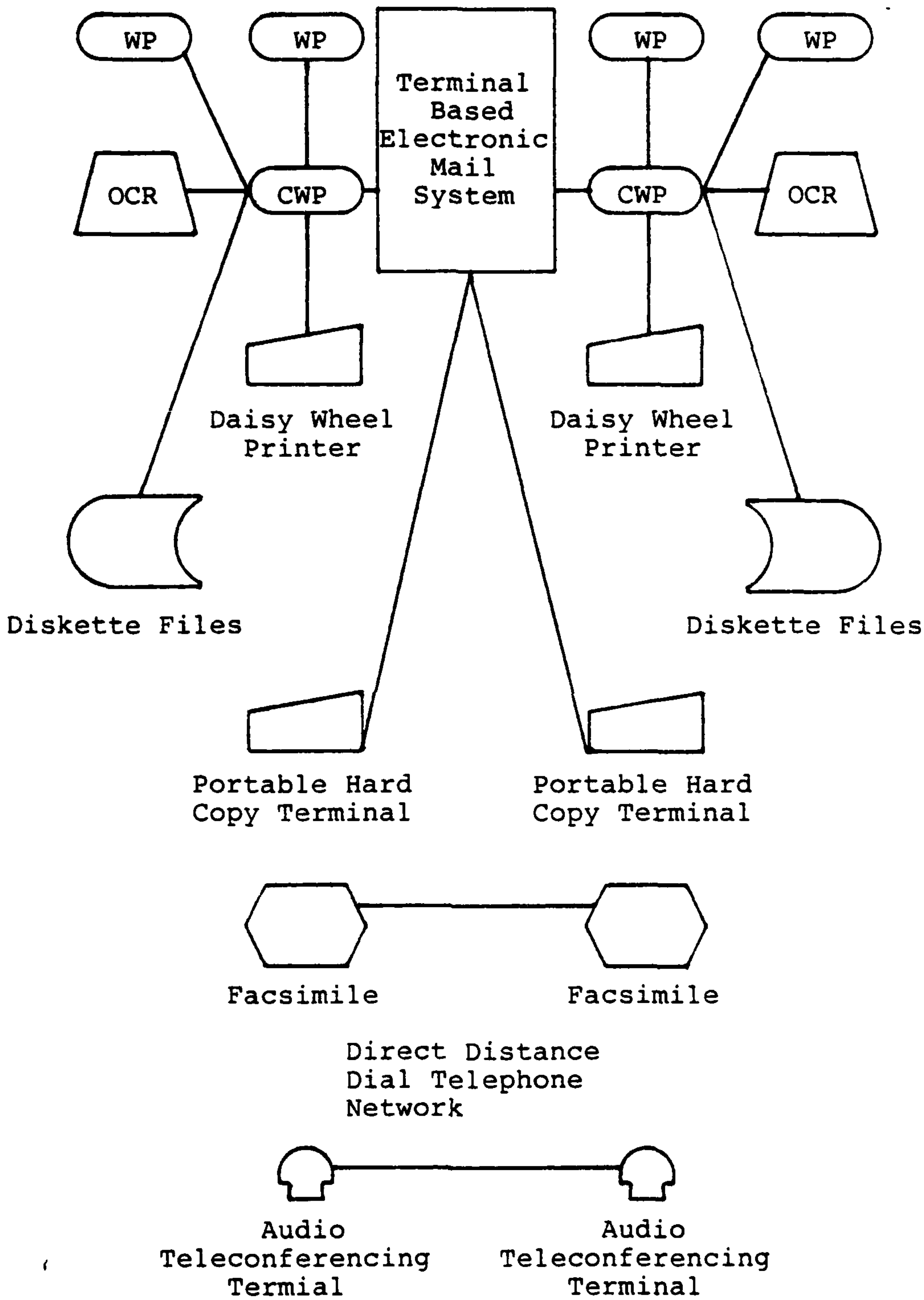

Figure F-1. Four-Mode System with Shared-Logic Work Processors

APPENDIX G

A FOUR-MODE SYSTEM WITH TIMESHARING GRAPHICS

Software
- Word processing software with communications
- Integrated office automation system timesharing/software

Features
- Text
  - Standalone communicating word processing (WP)
  - Optical character recognition input to word processor
  - Point-to-point electronic mail (communicating WP systems)
  - Computer-based electronic mail (CBMS)
  - Portable electronic mail
  - On-line document preparation (CBMS)
  - Off-line document preparation (word processor)
  - Multiauthor document preparation (CBMS)
  - Electronic document distribution
  - Categorized multidocument natural-language filing
  - Filing in medium/large minicomputers (optional; from WP system)
  - Automated file searching
  - Tickler function
  - Telephone message file
  - Electronic calendar
  - Automated appointment scheduling (multiperson)
  - Electronic publishing
  - On-line user directories
  - Personnel locator system (names, telephone numbers, etc.)
  - Torn-tape message center connection to TWX and telex
  - Direct interconnection to TWX/telex networks
  - Sort utility (in WP system)
  - Math utility (in WP system)
  - Computer teleconferencing (pseudo form using CBMS)
  - Off-line phototypesetting
  - COM output (off-line)
  - Open-loop computer-aided retrieval
- Data
  - Access to coresident DP tasks and files in CBMS
  - Access to outside data bases and DP services
  - Sort utility (in WP and DP systems)
  - Math utility (in WP and DP systems)
- Text/Graphic
  - Graphic electronic mail - facsimile
  - Portable facsimile

Graphic
  Video projection ofIOAS graphic images (local)
  Slow-scan video (black-and-white)
  Open-loop computer-aided retrieval (off-line micrographics)
  Local computer graphics (color pen plotter)
  Timesharing graphics (black-and-white)
Audio
  Voice-response electronic mail
  Audio teleconferencing
  Dictation - local

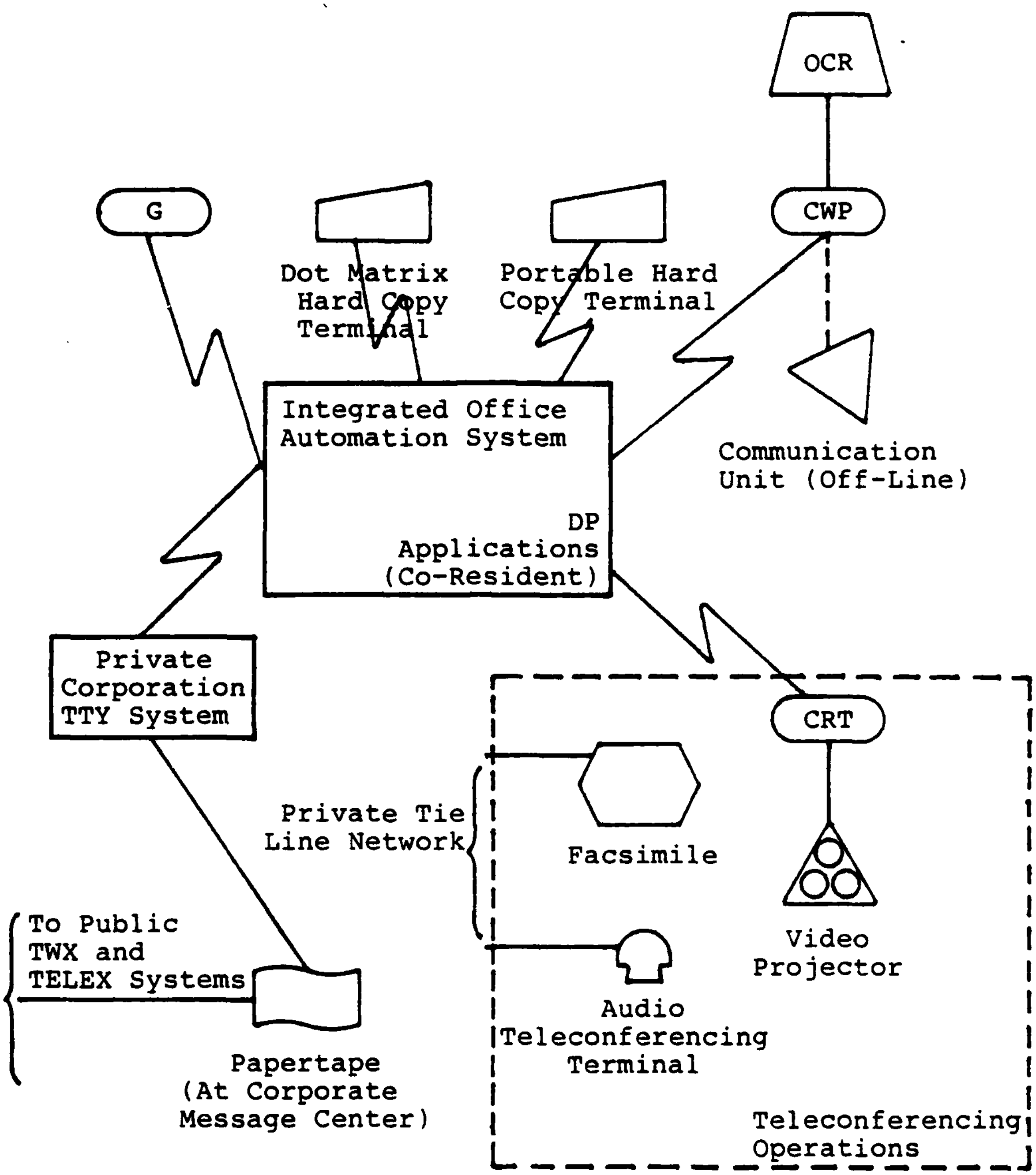

Figure G-1. Four-Mode System with Timesharing Graphics

APPENDIX H

IMPLEMENTATION PLANNING PROCEDURES

	TYPICAL % OF TOTAL EFFORT WITHIN PHASE
Phase I - System Planning	
Step 1 - Initial Investigation	10-20
Step 2 - Feasibility Study	80-90
Phase II - System Requirements	
Steps 1 and 2	40-50
Operations and Systems Analysis	
User Requirements	
Steps 3 and 4	40-50
Technical Support Approach	
Conceptual Design and Package Review	
Step 5 - Alternative Evaluation and Development	20-30
Phase III - Systems Development	
Steps 1 and 2	20-30
Systems Technical Specifications	
Technical Support Development	
Steps 3 and 4	40-60
Applications Specifications	
Applications Programming and Testing	
Steps 5 and 6	15-20
User Procedures and Controls	
User Training	
Steps 7 and 8	5-10
Implementation Planning	
Conversion Planning	
Step 9 - Systems Test	10-20
Phase IV - Systems Implementation	
Step 1 - Conversion and Phased Implementation	70-80
Step 2 - Refinement and Tuning	15-25
Step 3 - Post-Implementation Review	5-10

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